TOPCON

AGForm-3D

User's Manual

TOPCON
POSITIONING SYSTEMS

AGForm-3D
User's Manual

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Preface

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NOTICE

Please read these Terms and Conditions carefully.

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Manual Conventions

This manual uses the following conventions:

Example	Explanation
File->Exit	Click the File menu and click Exit.
Enter	Indicates the button or key labeled Enter.
Topo	Indicates the name of a dialog box or screen.
Notes	Indicates a field on a dialog box or screen, or a tab within a dialog box or screen.

TIP

Supplementary information that can help you configure, maintain, or set up a system.

NOTICE

Supplementary information that can have an affect on system operation, system performance, measurements, personal safety.

CAUTION

Notification that an action has the potential to adversely affect system operation, system performance, data integrity, or personal health.

Notes:

Introduction

Welcome to AGForm-3D™, an easy-to-use, field preparation, design, and layout program from Topcon Positioning Systems. AGForm-3D provides a full-featured environment for quickly and easily viewing, processing, and manipulating field data collected using this program or using AGS-100, Topcon's AG-3D machine control system.

After starting a project in AgForm-3D, you can use the program to:

- survey fields using a Topcon GPS receiver, including support for defining breaklines
- view and print contours and profiles
- design fields with best-fit or specified slopes
- divide the field into multiple sections, minimizing earthwork quantities
- measure and calculate field distances, areas, and volumes
- add, delete, and edit topo points
- view a 3D representation of the field
- create and print cut/fill maps
- import and export points, surfaces, and design files
- navigate to points in the field when connected to a GPS receiver

Installing AGForm-3D

AGForm-3D software comes on a CD ready to install on up to two (2) computers.

1. Insert the AGForm-3D CD into the CD-ROM drive. The InstallShield® Wizard starts up.
2. On the ***Choose Destination Location*** dialog box, either select a new destination folder or keep the default folder in which to install AGForm-3D, and click **Next**. The installation process begins (Figure 1-1).

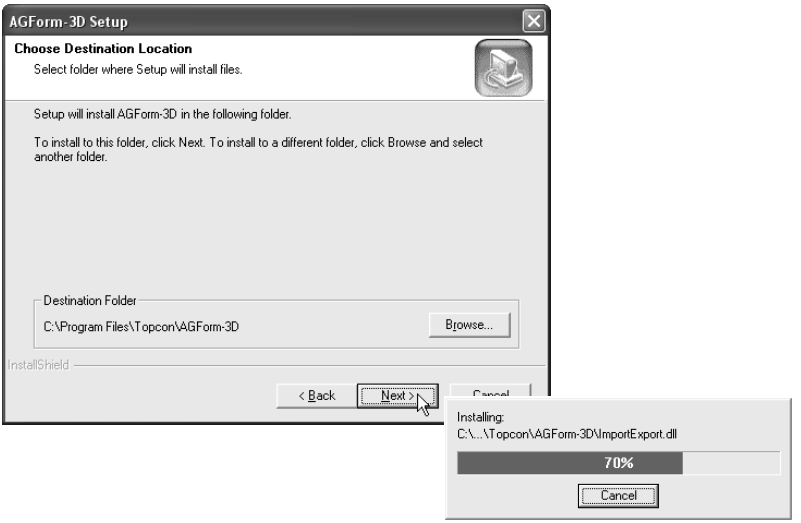


Figure 1-1. Install AGForm-3D

When finished, AGForm-3D also creates a shortcut to the program (Figure 1-2), placing it on the computer's Desktop.

Figure 1-2. AGForm-3D Shortcut

Uninstalling AGForm-3D

1. Navigate to the computer's ***add/remove programs*** dialog box and remove the AGForm-3D program.
2. On the remove ***AGForm-3D confirmation*** dialog box, click **Yes** (Figure 1-3).

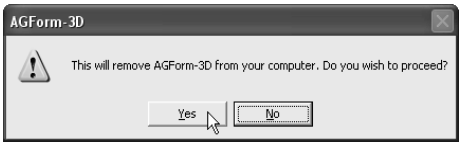


Figure 1-3. Remove AGForm-3D?

The ***Setup Status*** dialog displays, showing the uninstall progress (Figure 1-4).

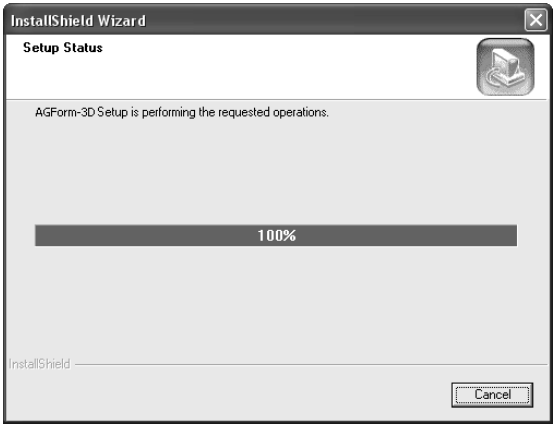


Figure 1-4. Setup Status – Uninstall AGForm-3D

3. Click **OK** to acknowledge the removal of AGForm-3D (Figure 1-5).

Figure 1-5. AGForm-3D Successfully Removed

Starting AGForm-3D

To start AGForm-3D, do one of the following:

- Double-click the **AGForm-3D shortcut**
- Click **Start->Programs->Topcon->AGForm-3D**

When starting AGForm-3D for the first time, the program requires two authorization codes to startup. Record the device identification number and contact your Topcon representative to acquire the appropriate authorization codes.

Enter the codes and click **OK** (Figure 1-6) to start AGForm-3D.

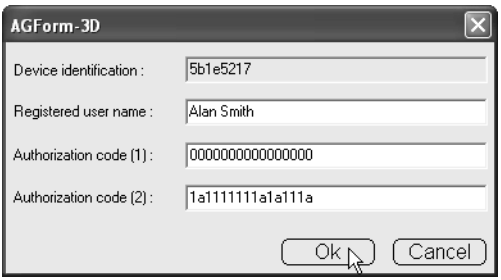


Figure 1-6. Enter Authorization Codes to Start AGForm-3D

To view the device ID and authorization codes at a later date, click **Help->About AGForm-3D**.

The AGForm-3D main screen displays (Figure 1-7 on page 1-5).

- When opening for the first time, no project displays on the main screen.
- When opening on subsequent occasions, the last project file opened displays on the main screen.

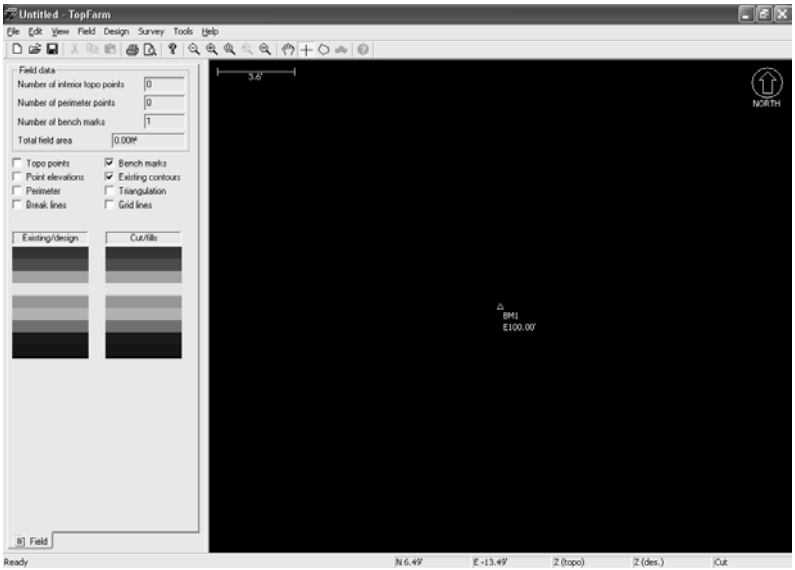


Figure 1-7. AGForm-3D Main Screen – No Current Project

See “File Operations” on page 1-19 for details on creating, opening, and saving projects.

Getting Acquainted

This section introduces the various menus, buttons, windows, and tabs available for viewing, managing, or editing project files.

Main Screen

The AGForm-3D main screen (Figure 1-8) has the following components:

- Menu bar – contains drop-down menus for the various functions.
- Toolbar – contains shortcut buttons to frequently used functions.
- Tab View – displays field information and configuration properties, as well as survey and navigation information.
- Design View – displays a graphical representation of the field, including its contours, data points, and cuts/fills.
- Status bar – displays informative messages about the program's status.

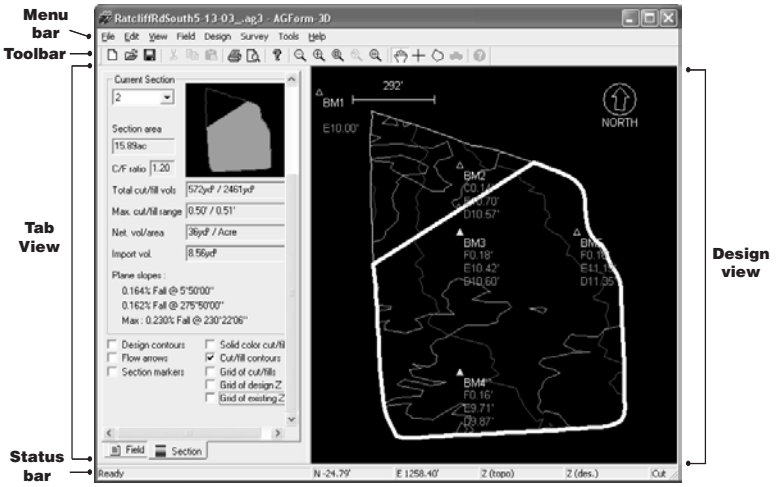


Figure 1-8. AGForm-3D Main Screen

Menu Bar

The menu bar (Figure 1-9) provides access to most AGForm-3D functions.

Figure 1-9. Menu Bar

File

The File menu (Figure 1-10):

- opens, saves, and exits a project file
- prints project maps
- defines variables for printing
- provides fast access to most recently used files

Figure 1-10. File Menu

Edit

The Edit menu (Figure 1-11):

- allows a redo or undo of the last operation
- cuts, copies, pastes, or deletes information

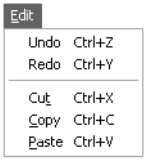


Figure 1-11. Edit Menu

View

The View menu (Figure 1-12 on page 1-9):

- zooms in by 200% and zoom out by 50% on the display screen
- zooms to a part of the design area indicated with a drawn window
- displays the previous Design View magnification
- displays the entire extents of the design area
- sets the Design View selection cursor
- selects all points and lines
- sets the view status for the Toolbar, Status bar, Scale bar, and North Arrow

TIP

On a mouse with a scroll wheel, use the scroll wheel to zoom dynamically; press down on the scroll wheel to pan dynamically.

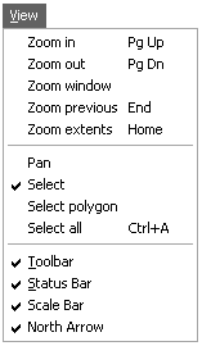


Figure 1-12. View Menu

Field

The Field menu (Figure 1-13):

- creates and edits master and secondary benchmarks
- sets the field orientation
- manages, displays, imports, and exports points
- exports topographic surfaces
- generates contours
- displays the 3D-view window

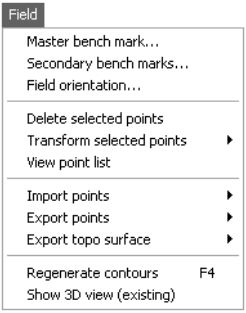


Figure 1-13. Field Menu

Design

The Design menu (Figure 1-14):

- designs and calculates field section(s) based on best-fit or fixed planes
- removes sections and cut/fill plots
- divides the field into sections or merges two sections of the field
- exports the current section to a 3D plane file
- displays the 3D view window
- generates a summary report of the field and design

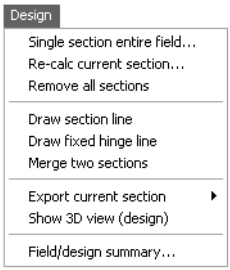


Figure 1-14. Design Menu

Survey

When attached to a GPS receiver, the Survey menu (Figure 1-15 on page 1-11):

- connects to the receiver and configures the GPS Base Station
- surveys master and secondary benchmarks
- performs perimeter, interior, and breakline surveys
- navigates to any point in the field or to manually entered coordinates

- performs a surface check, displaying the difference between the ground and the design surface at the current position

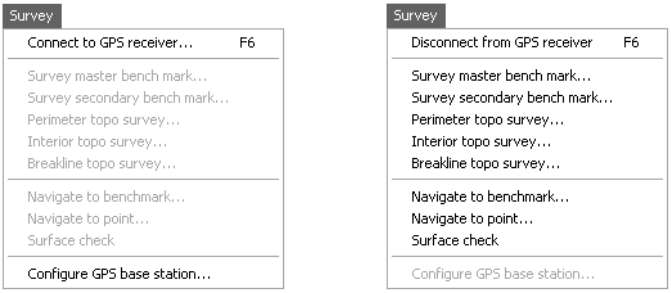


Figure 1-15. Survey Menu

Tools

The Tools menu (Figure 1-16):

- measures selected distances and areas
- joins perimeter lines
- defines and displays a field profile
- performs a subregion volume calculation, a powerful tool for evaluating grading progress
- performs a basic volume calculation (LxWxH)
- displays the trip meter during surveys
- displays the ***Options*** dialog box for setting and changing units, map properties, and equipment settings

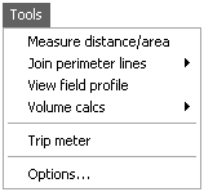


Figure 1-16. Tools Menu

Help

The Help menu (Figure 1-17) displays version level, copyright information, and authorization codes for AGForm-3D, as well as the device ID.

Figure 1-17. Help Menu

Toolbar

The Toolbar for AGForm-3D (Figure 1-18) contains buttons for frequently used functions.

Figure 1-18. Toolbar

- To display or hide the Toolbar, click **View->Toolbar**. A check mark indicates the Toolbar is visible.
- To move the Toolbar, click and hold the "grab bar" on the left of the Toolbar, then drag the Toolbar to a new location and release the mouse button.

Table 1-1 describes the various buttons on the Toolbar.

Table 1-1. Toolbar Button Functions

Button	Description
	New Project – Creates a new project. 1. Click the button to display the ***New Project Name*** dialog box. 2. Type the name of the project and select a folder on the hard disk drive or storage media in which to save the project. Click **Save**.
	Open Project – Opens a project. 1. Click the button to display the ***Open*** dialog box. 2. Navigate to the folder of the desired project and select the name of the project. Click **Open**.
	Save – Saves files to the current directory.

Table 1-1. Toolbar Button Functions (Continued)

Button	Description
	Cut – Removes the selected information from the page or window, placing it on the Windows® clipboard.
	Copy – Copies selected information from the page or window, placing it on the Windows clipboard.
	Paste – Places selected information from the Windows clipboard to the current cursor position.
	Print – Prints the Design View.
	Print preview – Displays how the Design View will look when printed.
	About – Displays the ***About AGForm-3D*** dialog box.
	Zoom Out – Zooms out from the map by 50%.
	Zoom In – Zooms in on the map by 200%.
	Zoom rectangle – Zooms to a rectangular area drawn in the Design View.
	Zoom previous – Displays the last magnification of the design.
	Zoom extents – Displays the entire area of the design.
	Pan – Changes the cursor to a “hand” with which to “grab” and move the map.
	Select – Changes the cursor to a crosshairs with which to click and select individual entities, or to click and drag over an area, creating a rectangle around desired information.
	Poly-cursor – Changes the cursor to a crosshairs with which to draw a polygon around desired information.
	Auto-pan – When in survey mode, displays the current position of the GPS receiver on the design surface.
	Information – Displays a text editor window containing information about the selected entities.

Tab View

The Tab View provides information panes that include cut/fill, point, area, and field volume information; has check boxes for displaying contour, cut/fill, elevation, and other information in the Design View; and provides various interfaces for surveying and navigation, and for monitoring GPS status.

TIP

Change the width of the Tab View to show any hidden information. In the Tab View, use the mouse wheel to control the scroll bar, or on the Design view to control zooming functions, after clicking on the desired View.

Field Pane

The Field pane (Figure 1-19 on page 1-15):

- displays field data information
- provides selection boxes for displaying information

The length of the existing/design color chart depends on the contour interval.

Section Pane

Only available when a design surface exists (that is, the project has one or more sections), the Section pane (Figure 1-19 on page 1-15):

- displays total field area, cut/fill, volume, and import information
- indicates the current section's area, cut/fill, volume, and import/export information
- displays the current section's slopes

- provides selection boxes for displaying information in the Design View

To create one or more sections on the field design, see “Creating and Merging Sections” on page 3-7.

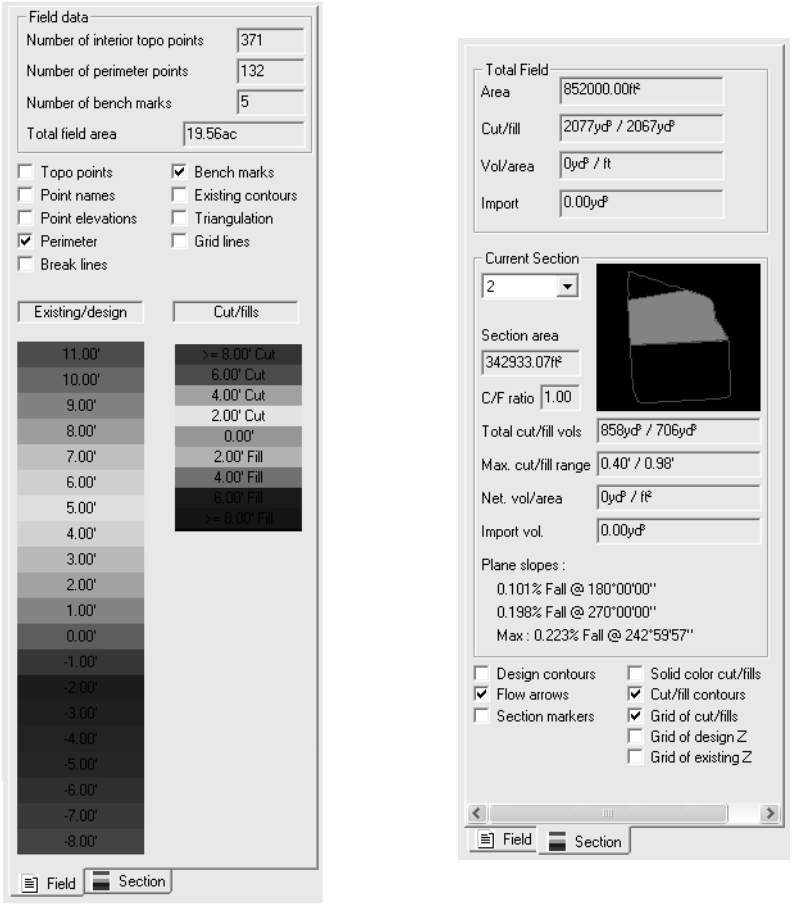


Figure 1-19. Field and Section Panes

GPS Pane

Available when a GPS receiver is connected, the GPS pane (Figure 1-20 on page 1-17):

- gives the receiver identification number and firmware revision level
- provides current coordinates, the status of the GPS receiver's position, and the number and type of tracked satellites
- gives the RMS value (RMS = Root Mean Square), an estimation of the position's precision
- shows the DOP (dilution of precision), an indication of the quality of the satellite geometry

For more information on GPS functionality, or to connect to a Topcon GPS receiver, see "Surveying with AGForm-3D" on page 5-1.

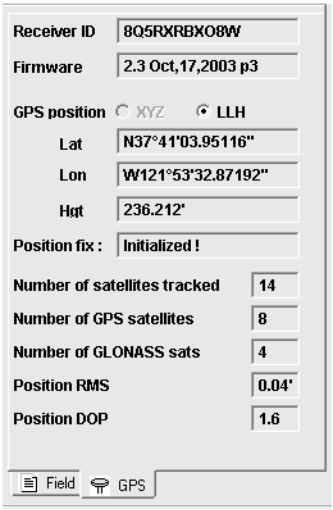
Survey and Navigation Panes

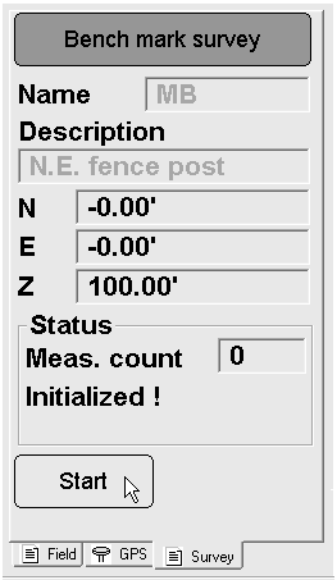
Available when a GPS receiver is connected, and a survey or navigation routine selected from the Survey menu, the Survey pane (Figure 1-20 on page 1-17):

- shows initialization status of the GPS receiver
- depending on the selected function, shows point coordinates and other information pertinent to the survey
- provides results for on-going or completed surveys

The color of the title block at the top of the Survey pane indicates the initialization status of the GPS receiver: red is not initialized, green is initialized.

For more information on surveying and navigating, see "Surveying with AGForm-3D" on page 5-1.





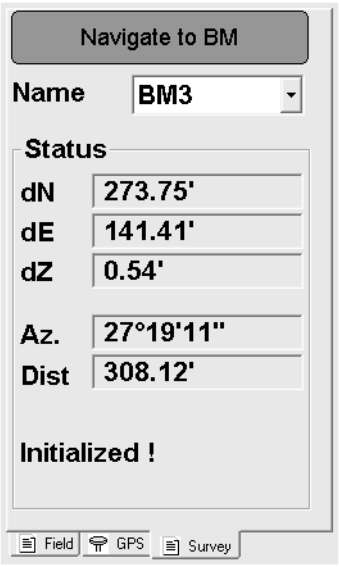


Figure 1-20. GPS, Survey, and Navigation Panes

Design View

The Design View graphically displays field information (Figure 1-21). Use the mouse wheel to zoom in/out and pan.

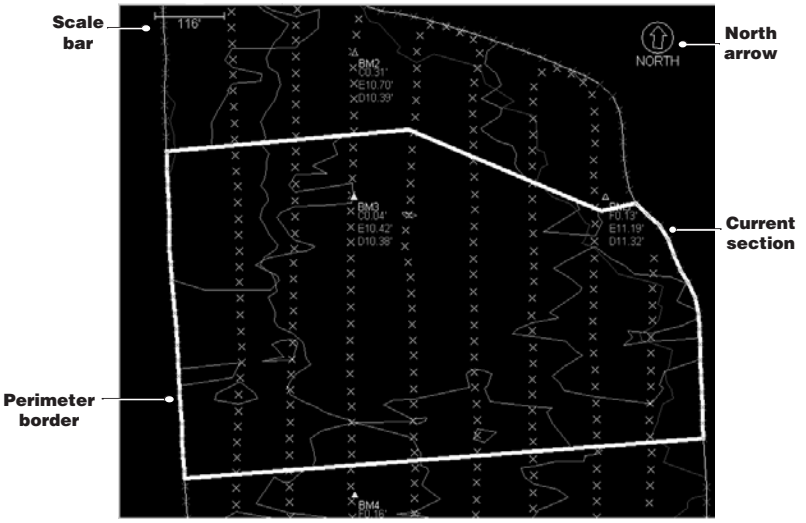


Figure 1-21. Design View

Use the check boxes on the Field and Section panes to select the type of information to display, including:

- benchmarks, points, point elevations
- existing field contours, cut/fill contours
- grid values for cut/fill, design Z, existing Z

Use the *Field* tab on the ***Options*** dialog box (**Tools->Options**) to set *Topo Design* and *Grid* parameters, including:

- color and grid intervals
- cut/fill and grid color schemes
- grid orientation

See “Viewing and Changing Options” on page 4-16 for more information on the ***Options*** dialog box.

Status Bar

The Status bar displays the current program status, calculation progress bars, and position and cut/fill values at the cursor's position in the Design View (Figure 1-22).

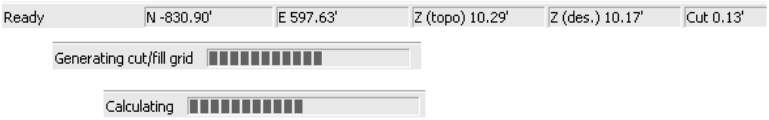


Figure 1-22. Status Bar

File Operations

From the File menu, you can create, open, and save project files. You can also preview and print the Design View, as well as enter title block information and font size for any printed material (Design View, Field Summary, etc.).

The following sections describe creating a new file, opening and saving files, printing the Design View, and using the Print Setup feature.

Creating a New Project File

To create a new file, do one of the following:

- Click **File->New** (Figure 1-23).

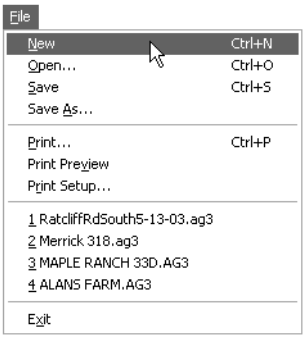


Figure 1-23. Open New File

- Press **Ctrl**+**N**.
- Click the **New** button on the toolbar (Figure 1-24).

Figure 1-24. Toolbar – New Button

On the ***New Project Name*** dialog box, navigate to the location to save the file, enter a title for the new project, and click **Save** (Figure 1-25).

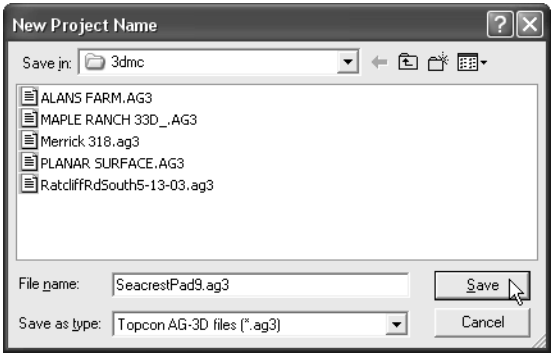


Figure 1-25. Name and Save New Project File

Once created, AGForm-3D opens the project file.

- See Chapter 2 for basic field and project data management.
- See Chapter 3 for designing a project.
- See Chapter 4 for field calculations and equipment settings.
- See Chapter 5 for surveying and navigation activities.

Opening a Project

An AGForm-3D project file contains data and information needed for viewing, designing, and managing a field. Only one project file can be open at a time.

AGForm-3D projects have a *.ag3 extension. By default, these files are to the last selected folder on your computer's hard drive. However, files can be saved to and opened from any selected folder.

To open a file, do one of the following:

- Click **File->Open** (Figure 1-26).

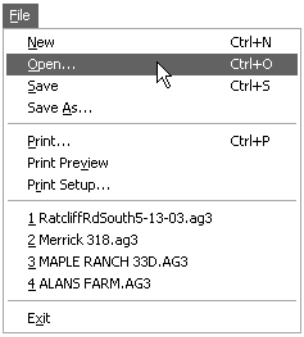


Figure 1-26. Open a File

- Press **Ctrl**+**O**.
- Click the **Open** button on the toolbar (Figure 1-27).

Figure 1-27. Toolbar – Open Button

On the ***Open*** dialog box, navigate to the location of the file, select it, and click **Open** (Figure 1-28).

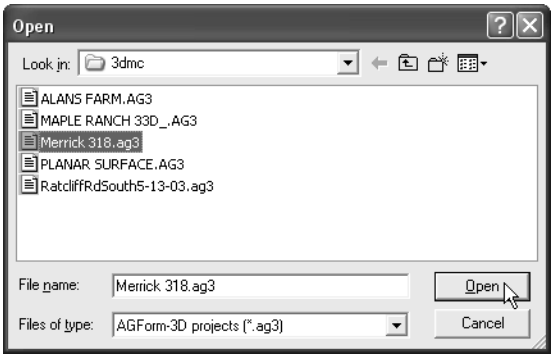


Figure 1-28. Select File to Open

- Click a previously opened file (Figure 1-29).

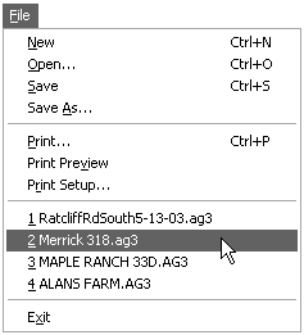


Figure 1-29. Open a Previous File

Saving a Project

AGForm-3D only saves project files with a *.ag3 extension. To save a project, do one of the following:

- Click **File->Save** (Figure 1-30).

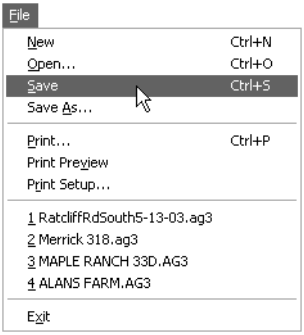


Figure 1-30. Save File

- Press **Ctrl**+**S**.
- Click the **Save** button on the toolbar (Figure 1-31).

Figure 1-31. Toolbar – Save Button

- Click **Yes** on the *Save changes* confirmation when opening another file or closing AGForm-3D after making changes (Figure 1-32).

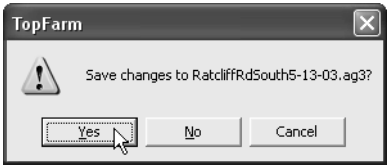


Figure 1-32. Save Changes

To save the file under a different name, click **File->Save As** (Figure 1-33).

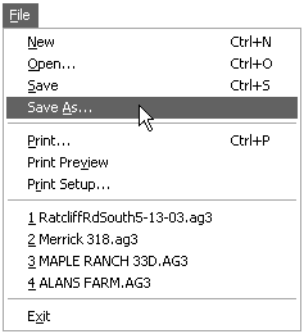


Figure 1-33. Save File with a Different Name or in Another Location

TIP

Save the file as a variant of the original file to keep a backup copy or to track progress.

Navigate to the location in which to save the file, enter a name for the file, then click **Save** (Figure 1-34).

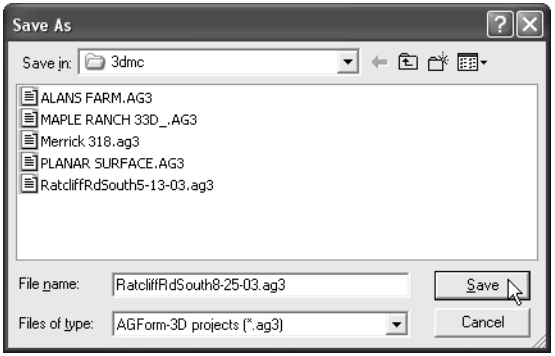


Figure 1-34. Save File As...

Printing the Design View

TIP

Before printing, check a printout of the map using Print Preview (see “Print Preview” on page 1-26 for details).

To print the Design View, do one of the following:

- Click **File->Print** (Figure 1-35).

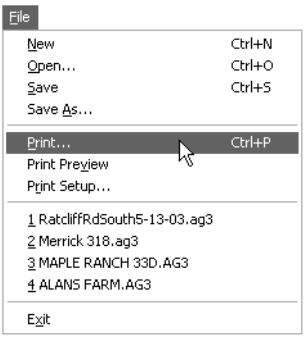


Figure 1-35. Print Design View

- Press **Ctrl**+**P**.
- Click the **Print** button on the toolbar (Figure 1-36).

Figure 1-36. Toolbar – Print Button

To print Field Summary information, see “Printing the Field Summary” on page 3-28.

Print Preview

Use the Print Preview function to see how printed information will look on paper. Use this preview to determine the look of printed documents; such as, orientation, font size, etc.

TIP

Depending on the previous print parameters set in the Print dialog box, the Print Preview will be in either portrait or landscape orientation.

To view the print preview, do one of the following:

- Click **File->Print Preview** (Figure 1-37).

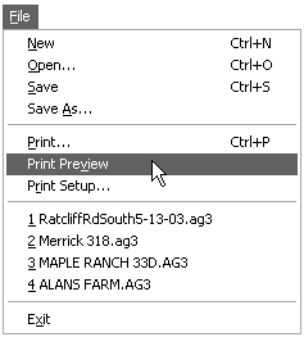


Figure 1-37. Open Print Preview

- Click the **Print Preview** button on the toolbar (Figure 1-38).

Figure 1-38. Toolbar – Print Preview Button

The print preview dialog box displays what the Design View will look like when printed (Figure 1-39).

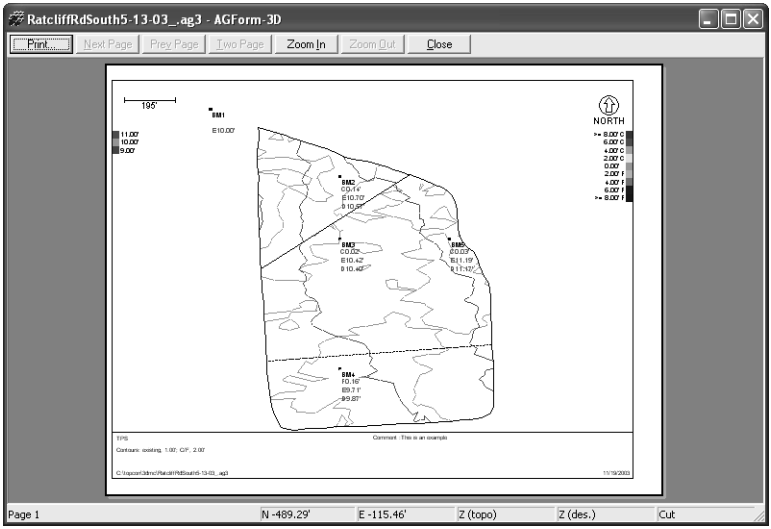


Figure 1-39. Print Preview of the Design View

Print Setup

Click **File->Print Setup** to change title block information and set the font size for reports and Design View labels (Figure 1-40).

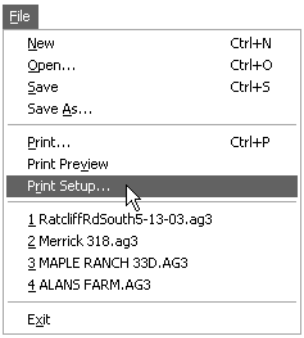


Figure 1-40. Setup Printing Parameter

Use the ***Print setup*** dialog box to set the following (Figure 1-41):

- Company name – enter owner/user information to include in the title block. This is a global field. When set, it will be applied to all jobs until changed.
- Comment – enter desired information to include in the Comment area of the title block. This is a project dependent field. Changing it in one project does not affect settings in other jobs.
- Text font – sets the text size in reports and title blocks.
- Map font – sets the text size for entities viewed in the Design View, such as point names, coordinates, etc.

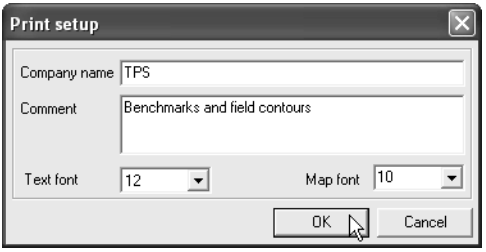


Figure 1-41. Print Setup

Field Management

This chapter describes using AGForm-3D to manage point data, including:

- defining, viewing, and editing master and secondary benchmarks
- adjusting elevations, and translating or rotating coordinates
- viewing points
- importing, adding, deleting, and editing point information
- generating contours
- displaying a 3-dimensional view of the existing surface

With AGForm-3D you can operate on the entire data set or a subset of the data in a single action; for example, adjusting elevations and translating or rotating coordinates.

AGForm-3D projects have a *.ag3 extension. By default, these files are saved in the last selected folder on your computer's hard drive. However, files can be saved to and opened from any selected folder.

Benchmarks

Benchmarks are reference points at or near the project site that provide coordinate information for project applications. Benchmarks are the control points that help keep grading, land-leveling, and surveying accurate and consistent.

AGForm-3D recognizes two kinds of benchmarks: master and secondary. A file contains one master benchmark and as many secondary benchmarks as needed.

Viewing Master Benchmark Information

1. To view master benchmark information, do one of the following using the Select tool, then click the activated **Information** button (Figure 2-1):
   - Draw a rectangle around the benchmark.
   - Click the benchmark.

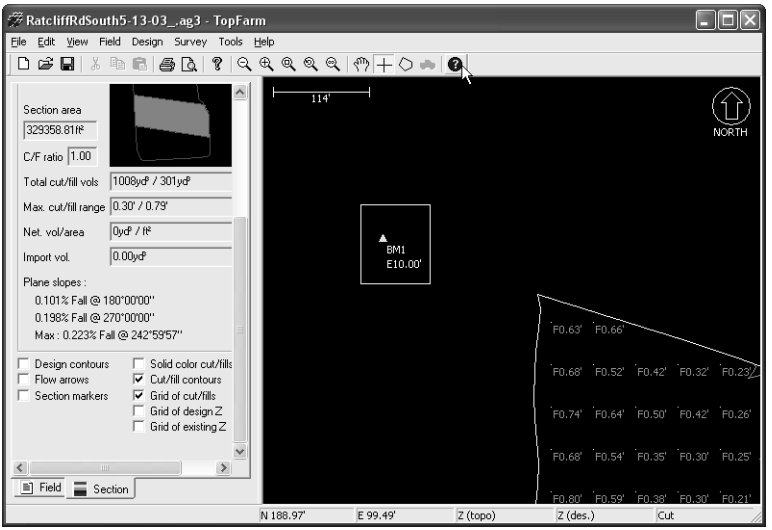


Figure 2-1. Select Master Benchmark and Click Information

2. On the ***information*** dialog box, view or save the master benchmark information to a text file (Figure 2-2). This action has no affect on the values stored in the project.

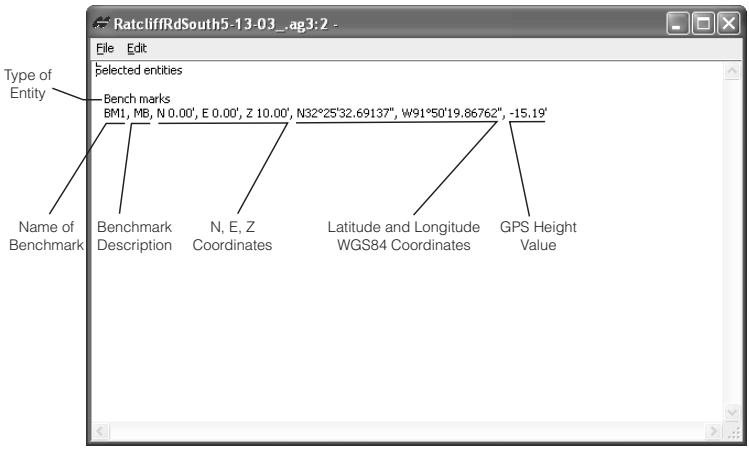


Figure 2-2. Master Benchmark Information

- To save the information as a text file, click **File->Save as**. On the ***Save As*** dialog box, enter a name and select a location for the file, then click **Save** (Figure 2-3).

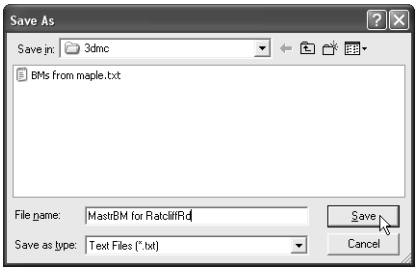


Figure 2-3. Save Master Benchmark Information as a Text File

- To copy contents to the clipboard, highlight the desired information and click **Edit->Copy**.

Editing the Master Benchmark

1. Click **Field->Master bench mark** (Figure 2-4).

Figure 2-4. View or Edit Master Benchmark

2. On the ***Master bench mark*** dialog box, enter the following parameters and click **Ok** (Figure 2-5):
   - Name – the name of the benchmark
   - Description – a description for the benchmark
   - North, East, Elev – the field location of the master benchmark; by default, 0.00, 0.00 and 10.00, respectively.

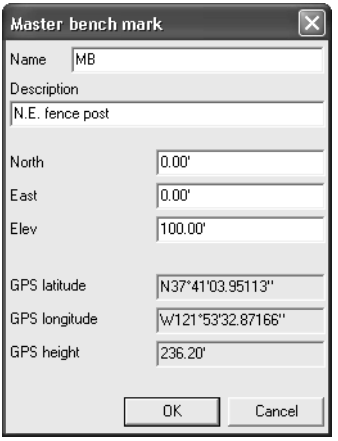


Figure 2-5. Master Benchmark Dialog Box

Viewing Secondary Benchmark Information

1. To select individual secondary benchmarks, do one of the following using the Select tool, then click the activated **Information** button on the toolbar (Figure 2-6):
   - Draw a rectangle around the benchmark.
   - Click the benchmark.

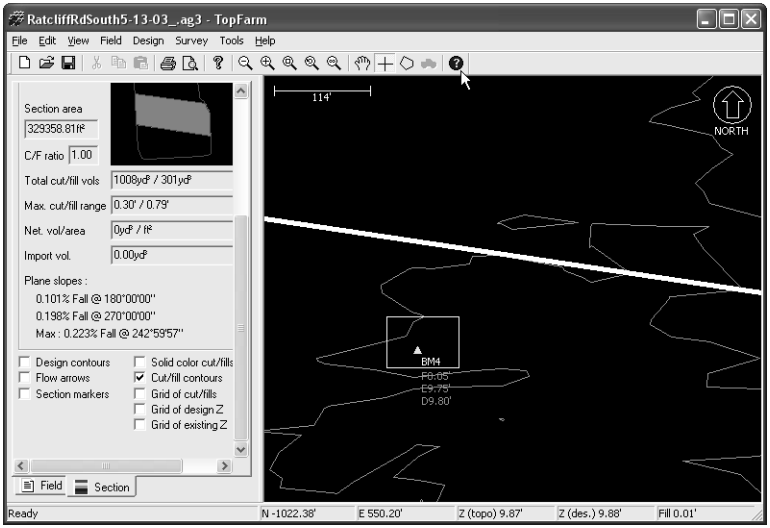


Figure 2-6. Select a Secondary Benchmark and Click Information

2. On the ***information*** dialog box, view or save the secondary benchmark information to a text file (Figure 2-7). This action has no affect on the values stored in the project.

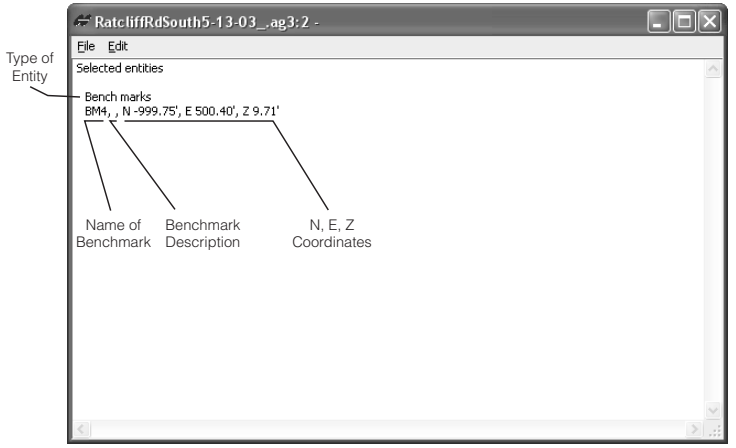


Figure 2-7. Secondary Benchmark Information

- To save the information as a text file, click **File->Save as**. On the ***Save As*** dialog box, enter a name and select a location for the file, then click **Save** (Figure 2-8).

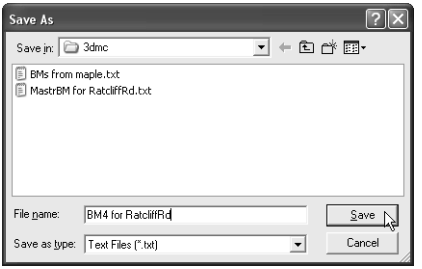


Figure 2-8. Save Secondary Benchmark Information as a Text File

- To copy contents, highlight the desired information and click **Edit->Copy**.

Editing Secondary Benchmarks

1. Click **Field->Secondary bench marks** (Figure 2-9).

Figure 2-9. View Secondary Benchmarks

The ***Bench marks*** dialog box lists all secondary benchmarks and their respective information (Figure 2-10).

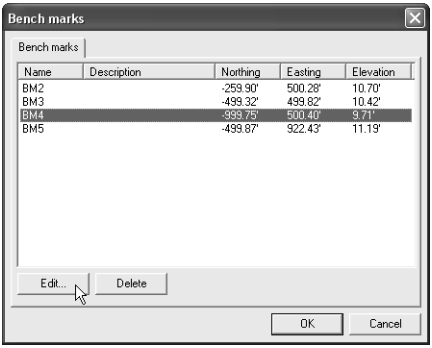


Figure 2-10. Secondary Benchmarks Dialog Box

2. Select the desired benchmark and click **Edit** to edit secondary benchmark information (Figure 2-10).

3. On the ***Edit benchmark*** dialog box, enter the following parameters and click **Ok** (Figure 2-11):
   - Name – the name of the benchmark
   - Description – a description for the benchmark
   - North, East, Elev – the coordinates of the secondary benchmark in relation to the Master Benchmark.

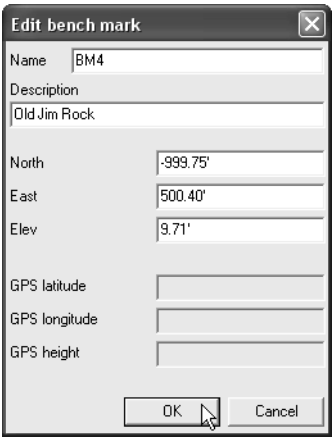


Figure 2-11. Benchmark Dialog Box

4. To delete a benchmark, select it and click **Delete** on the ***Bench marks*** dialog box (Figure 2-10 on page 2-7). Click **Yes** on the confirmation dialog box (Figure 2-12).

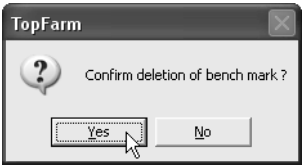


Figure 2-12. Confirm Deletion

5. Click **Ok** on the ***Benchmarks*** dialog box to save any changes (Figure 2-13).

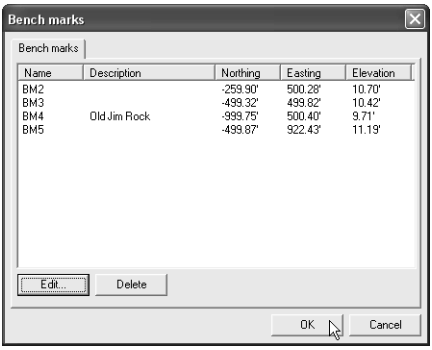


Figure 2-13. Click Ok Save Changes

Field Orientation

Point rotation changes the point coordinate values by rotating the field with respect to north.

1. Click **Field->Field orientation** (Figure 2-14).

Figure 2-14. Rotate Points

2. On the ***Field orientation*** dialog box, enter the angle, clockwise from north, in the current angle format. Click **OK** to set the new orientation (Figure 2-15 on page 2-10).

3. On the ***confirm re-orientation*** dialog box, click **OK** to continue (Figure 2-15).

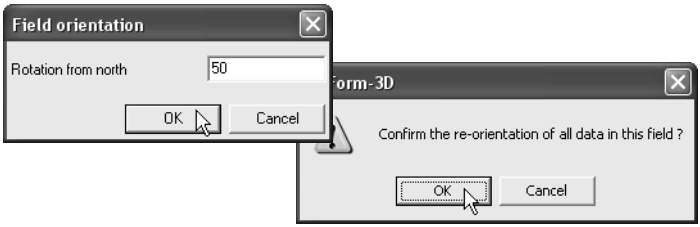


Figure 2-15. Set Field Orientation and Confirm Change

The field rotates to the new orientation, and the North arrow rotates by the same amount.

Rotating the orientation changes the coordinates in the data base. To return to the original coordinates, set the rotation angle to zero.

Points

A field's points include all perimeter, interior, and breakline points. With AGForm-3D, you can view the coordinates, add or delete points, and adjust or translate coordinates.

Viewing Points in the Design View

To view points and elevations in the Design View, click and enable the **Topo points** and/or **Point elevations** on the *Field pane* (Figure 2-16 on page 2-11). If the points also have an associated name, click **Point names**.

- Perimeter points display as a purple "x" marker.
- Interior points display as a white "x" marker.
- Breakline points display as a purple "x" marker.

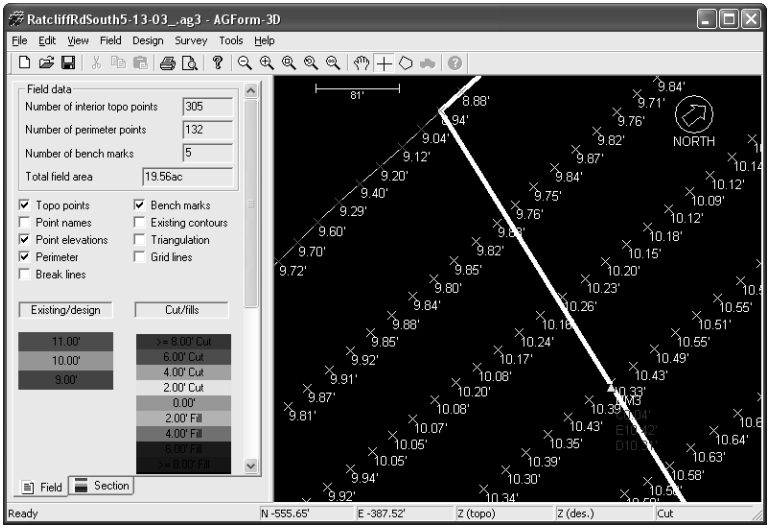


Figure 2-16. Topo Points and Elevations

Viewing Information for Selected Points

1. To view information for selected points, do one of the following using the Select tool:
   - Draw a rectangle or polygon around the desired points (Figure 2-17).
   - For multiple points, hold down the **Control** key and click the desired points.

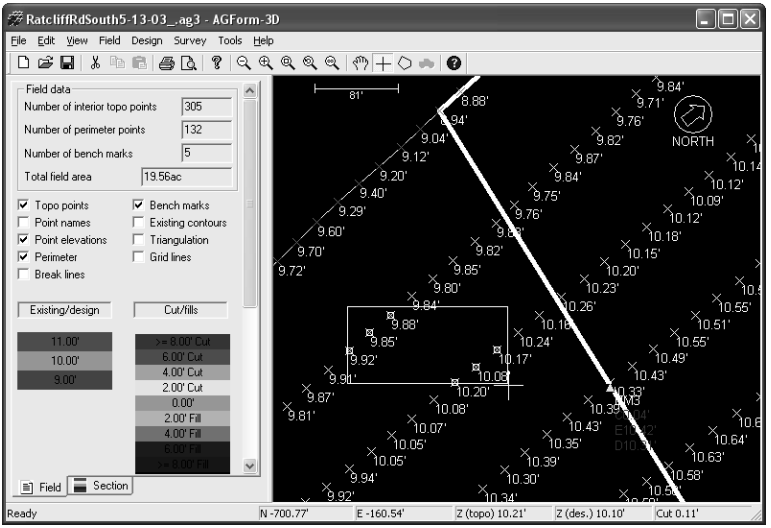


Figure 2-17. Select Points

2. Click the **Information** button to display the ***information*** dialog box (Figure 2-18).

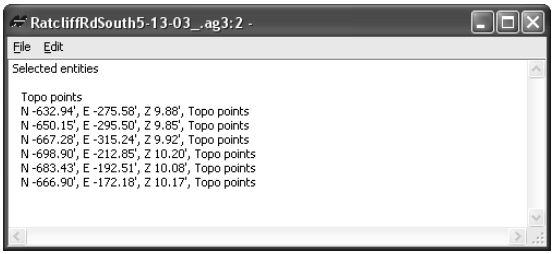

RatcliffRdSouth5-13-03_.ag3:2 -
File Edit
Selected entities
Topo points
N -632.94', E -275.58', Z 9.88', Topo points
N -650.15', E -295.50', Z 9.85', Topo points
N -667.28', E -315.24', Z 9.92', Topo points
N -698.90', E -212.85', Z 10.20', Topo points
N -683.43', E -192.51', Z 10.08', Topo points
N -666.90', E -172.18', Z 10.17', Topo points

Figure 2-18. Selected Points Information

Viewing the Point List

To view a list of all points in the project file, click **Field->View point list** (Figure 2-19).

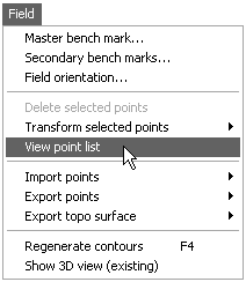


Figure 2-19. View Point List

The ***point list*** has the following information (Figure 2-20):

- Select – indicates selected points
- Pt. # – the number of the point (optional)
- Type – either Topo points, Topo perimeter, or Breakline points
- Northing, Easting, Elevation – point coordinates
- Created – the point's creation date and time

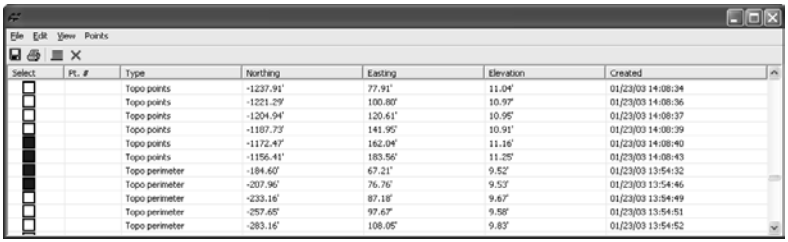


Figure 2-20. Point List

Save Point List as Text File

1. On the ***point list*** dialog box, click **File->Save As ASCII** (Figure 2-21).

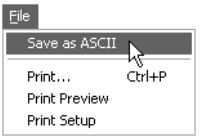


Figure 2-21. Save Point List as ASCII

2. On the ***Save As*** dialog box, enter a name and select a location for the file, then click **Save** (Figure 2-22). The current date, file name, and all records and fields shown in the point list are saved to an ASCII text file.

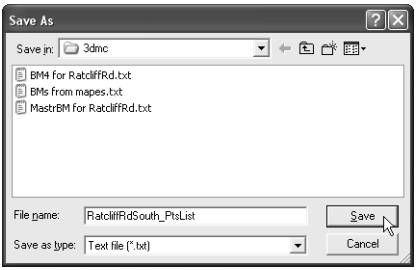


Figure 2-22. Save Point List as a Text File

Edit Point List

Only the point number, northing, easting, and elevation fields can be edited in the point list.

NOTE: Perimeter points cannot be edited in the point list if a design surface exists in the project.

1. Click to highlight the field to edit (editable fields turn yellow).
2. Click a second time or press **F2** to edit the value. Type in a new value (Figure 2-23 on page 2-15).

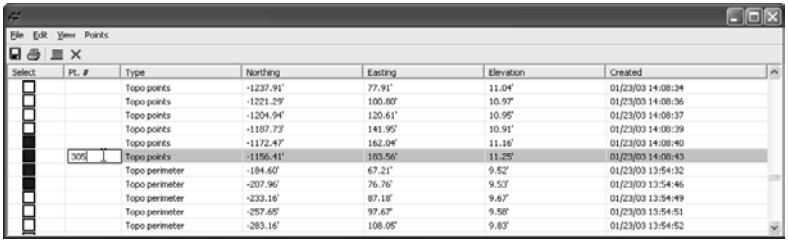


Figure 2-23. Edit Point Information

3. When finished, press **Enter** to set the new information.

Add Points to the Points List

To add a new Topo point to the ***point list***, do one of the following (Figure 2-24):

- Click **Points->Add point**.
- Click the **Add point** toolbar button.

Figure 2-24. Add Point

A new Topo point record appears at the bottom of the ***point list*** (Figure 2-25). Edit point number and coordinate fields as described in “Edit Point List” on page 2-14.

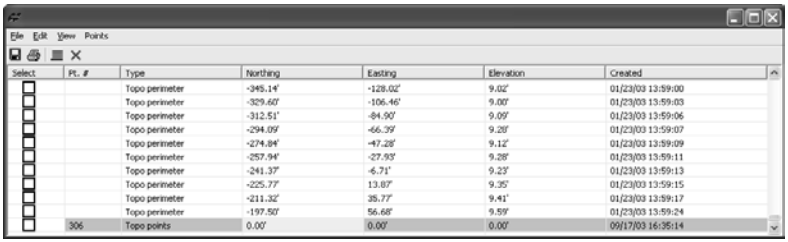


Figure 2-25. New Topo Point Added

The next time the points list opens, the new Topo point is grouped with its type and ordered by point name.

Delete Points from the Point List

NOTE: Perimeter points cannot be deleted in the ***point list*** if a design surface exists in the project.

1. To delete a point from the ***point list***, click the **Select box** to select the point or points to delete (Figure 2-26).

   The points selected here are also selected in the Design View.

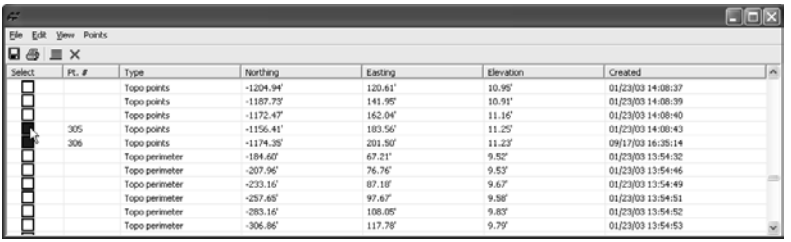


Figure 2-26. Select Point or Points to Delete

2. Press **Delete** or click one of the following (Figure 2-27) to delete the point or points:

   - **Points->Delete points**
   - The **Delete points** toolbar button

Figure 2-27. Delete Points from Point List

Deleting Selected Points

1. To delete selected points from the Design View, do one of the following:
   - Use the Select tool to draw a rectangle, or the Poly-cursor tool to draw a polygon, around the desired points (Figure 2-28).
   - Hold down the **Ctrl** key and click the desired points using the Select tool.

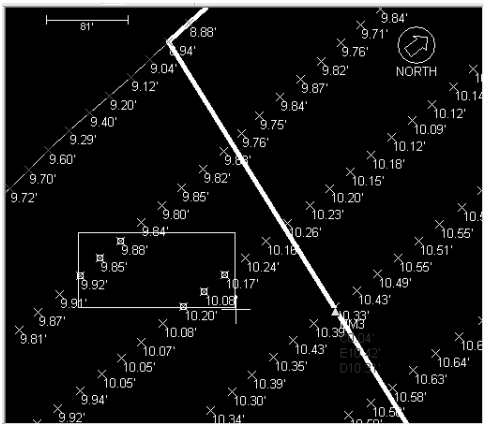


Figure 2-28. Select Points

2. Click **Field->Delete selected points** or press **Delete** to delete the points from the project file (Figure 2-29).

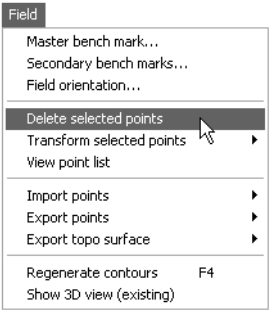


Figure 2-29. Delete Selected Points

Adjusting Point Elevations

The elevation adjustment is only a translation along the vertical axis. Point elevations may need to be adjusted for various reasons. For example:

- The surveyor may have assigned an arbitrary elevation to the master benchmark for the initial survey and later will want to reference the survey to a “true” or “known” benchmark elevation.
- A mistake may have been made in the height of the antenna, and the elevations will need to be corrected accordingly. If this occurred on one day of a multi-day survey, then only a subset of the data will need to be adjusted.

CAUTION

Use caution with this routine, especially when operating on a subset of the data.

1. Select the desired points to adjust (Figure 2-30).

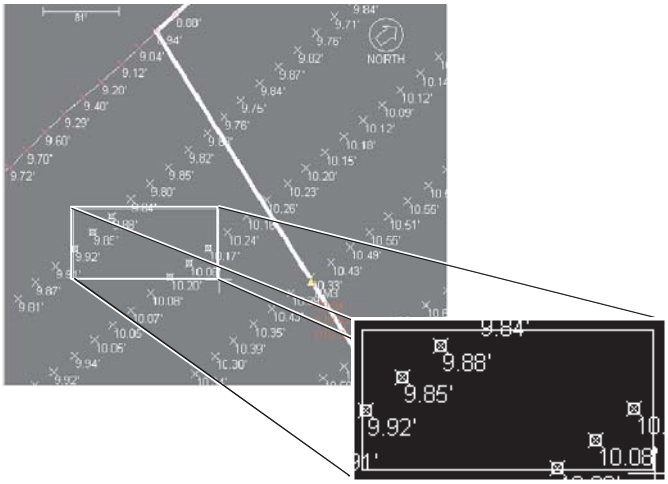


Figure 2-30. Select Points to Adjust

2. Click **Field->Transform selected points->Adjust elevations** (Figure 2-31).

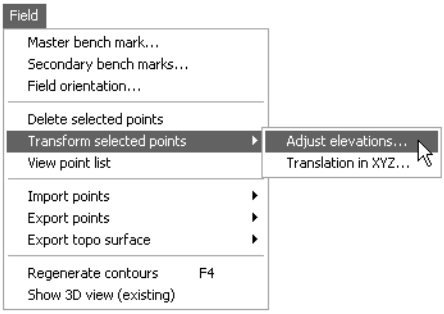


Figure 2-31. Adjust Point Elevations

3. On the ***Adjust elevations*** dialog box, enter a translation value for the selected points using the current project units and click **OK** (Figure 2-32). Use a negative value to reduce the elevations.

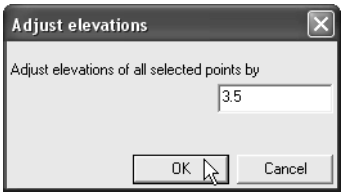


Figure 2-32. Adjust Elevations

In the Design View, the elevations of the selected points adjust to the new elevation (Figure 2-33).

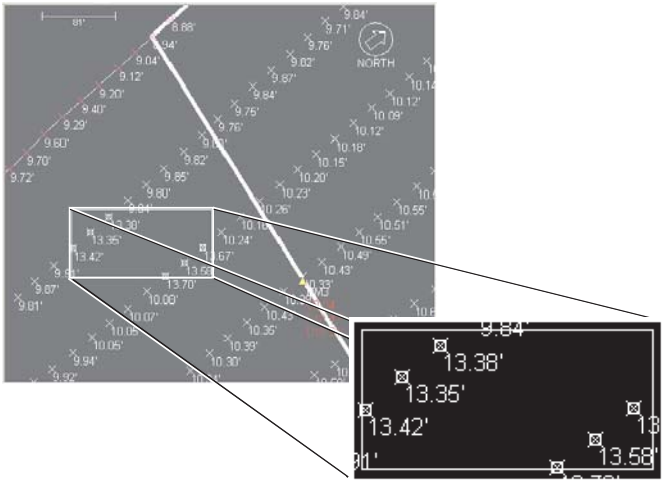


Figure 2-33. Adjusted Elevations of Selected Points

Translating Point Coordinates

Point translations are shifts along the three respective coordinate axes; that is, along the X (East), Y (North), and Z (Elevation) axes. Typically, point translations are done on the entire data set, if at all, rather than on a subset of points.

CAUTION

Use caution with this routine, especially when operating on a subset of the data; data will be permanently changed.

1. Select the desired points to translate (Figure 2-34).

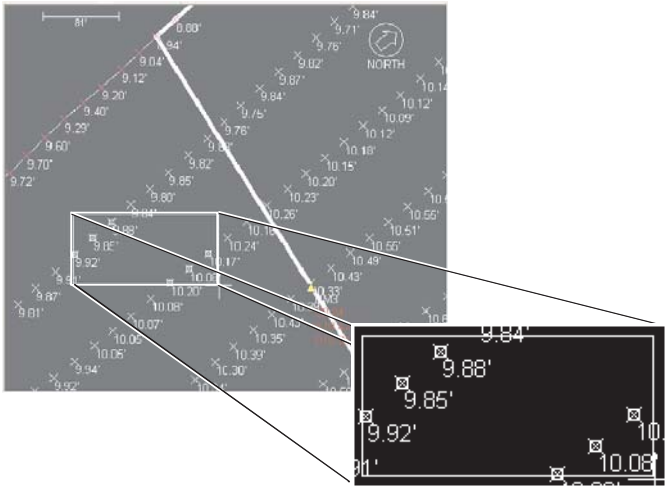


Figure 2-34. Select Points to Translate

2. Click **Field->Transform selected points->Translation in XYZ** (Figure 2-35).

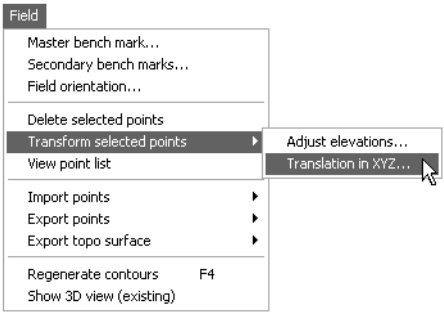


Figure 2-35. Translate Points

3. On the ***Translation*** dialog box, enter the amount to translate along each respective axis, and click **OK** (Figure 2-36).
   - Use zero for any axis along which a translation should not be performed.
   - Use a positive value to increase the coordinates.
   - Use a negative value to decrease the coordinates.

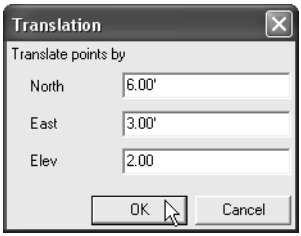


Figure 2-36. Enter Translation Value

In the Design View, the coordinates of the selected points change accordingly (Figure 2-37).

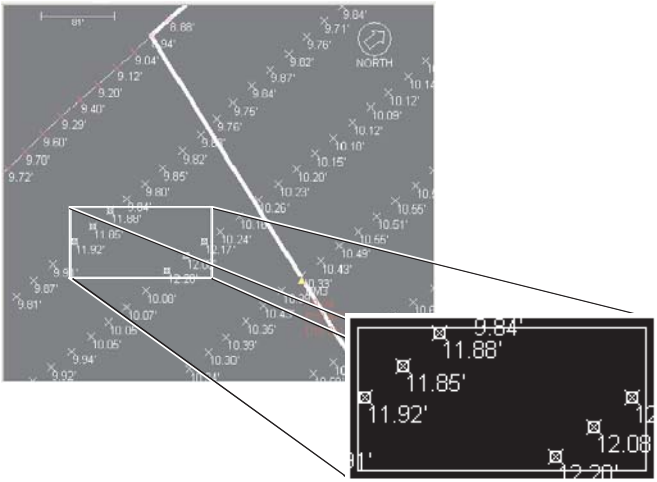


Figure 2-37. Translation of Selected Points

Importing and Exporting Points

With AGForm-3D, you can import points from or export points to text files. These text files contain point coordinate information in ASCII format, which can be viewed or edited in any text editor.

Importing Points from a Text File

Whether working with a new or existing project, you can import points saved as text files from other field projects.

1. Click **Field->Import points->From text file** (Figure 2-38).

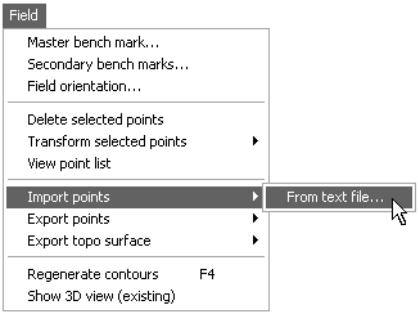


Figure 2-38. Import Points From Text File

2. On the ***Import points*** dialog box, click **Browse** (Figure 2-39).

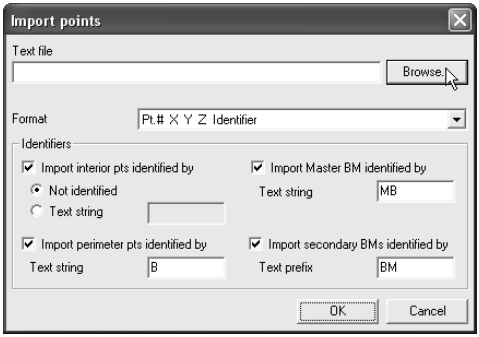


Figure 2-39. Browse for Text File

3. Navigate to and select the desired text file, then click **Open** (Figure 2-40).

Figure 2-40. Navigate to and Select Text File

4. On the ***Import points*** dialog box, select the following parameters and click **OK** (Figure 2-41 on page 2-25):

   - Format – click the drop-down list and select the format of the points in the text file. Be careful to choose the space or comma delimited format appropriately.
   - Identifiers – select the point type to import and enter the identifiers for interior and perimeter points, and for master and secondary benchmarks. An identifier is a text string at the end of a point record that identifies the point or benchmark as one type or another.

     Identifiers are optional for interior points. However, they are the means by which the program recognizes perimeter and benchmark points. Without an identifier, AGForm-3D assumes a point is an interior point.

TIP

You can use an asterisk (*) as a wildcard for the interior point text string. Wildcards are useful when multiple identifiers are associated with the set of interior points.

A wild card allows records with an identifier that does not match perimeter and benchmark point identifiers to be imported as an interior point.

Perimeter points must be listed in the order they will be linked. The first perimeter point need not appear again at the end of the perimeter points listing.

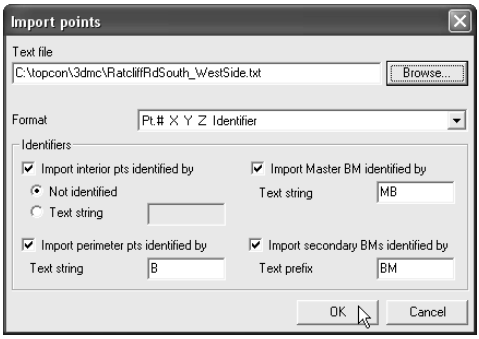


Figure 2-41. Select Import Parameters

The imported points display in the Design View (Figure 2-42).

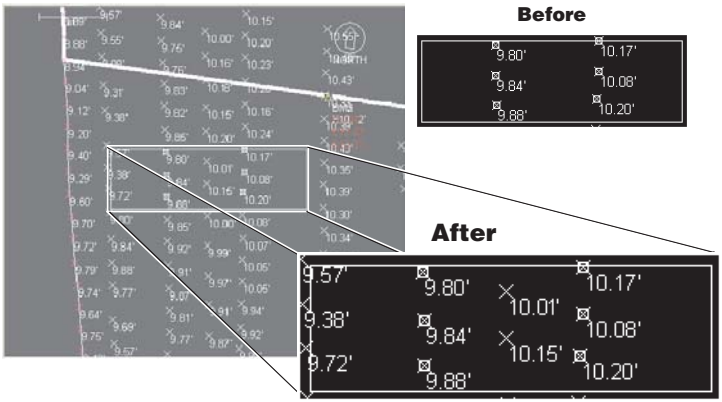


Figure 2-42. Points Added to Field and Project File

Exporting Points to a Text File

With AGForm-3D, you can export point information to text files for use in other projects or programs that can import ASCII text files.

1. Click **Field->Export points->To text file** (Figure 2-43).

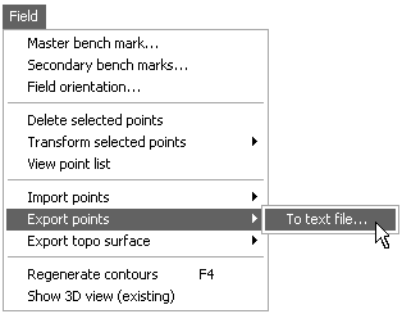


Figure 2-43. Export Points to Text File

2. On the ***Export points to text file*** dialog box, click **Browse** (Figure 2-44).

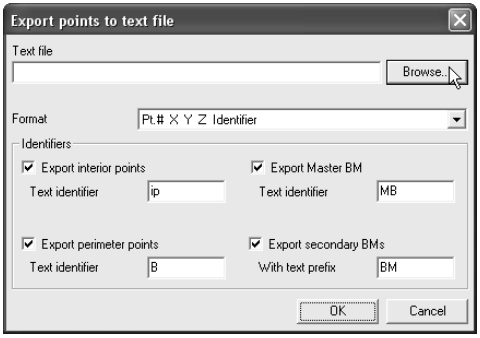


Figure 2-44. Browse for Text File

3. Navigate to the directory to export the file to, do one of the following, then click **Open**:
   - Type in a name for the new text file (Figure 2-45).
   - Select an existing file to export points to; the existing file will be overwritten.

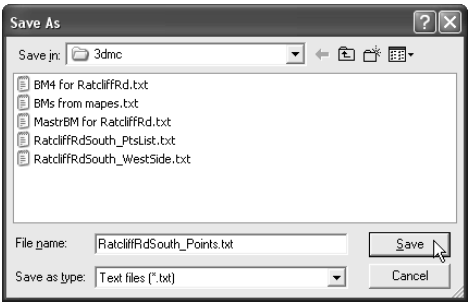


Figure 2-45. Navigate to and Select Text File

The path and file name displays in the *Text file* field on the ***Export points to text file*** dialog box (Figure 2-46 on page 2-28).

4. On the ***Export points to text file*** dialog box, select the following parameters and click **OK** (Figure 2-46 on page 2-28):
   - Format – click the drop-down list and select the format of the points in the text file.
   - Identifiers – select the points to export and enter the identifiers for interior and perimeter points, and master and secondary benchmarks. An identifier is a text string at the end of a point record that identifies the point or benchmark as one type or another (Figure 2-47 on page 2-28).

     Identifiers are optional for interior points. However, they are the means by which the program recognizes perimeter and benchmark points. Without an identifier, AGForm-3D assumes a point is an interior point.

Perimeter points must be listed in the order they will be linked. The first perimeter point need not appear again at the end of the perimeter points listing.

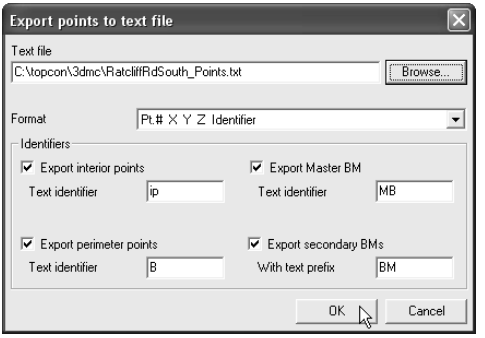


Figure 2-46. Select Import Parameters

Figure 2-47 shows identifiers as seen in a text editor.

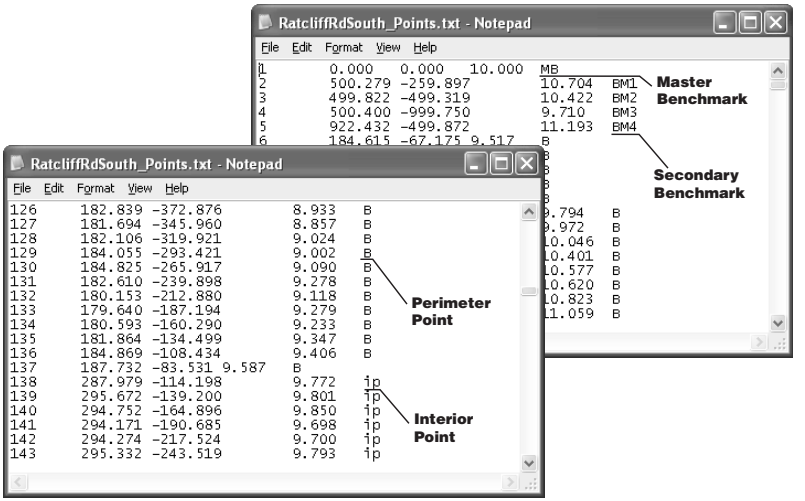


Figure 2-47. Text File Identifiers

Exporting a Topo Surface

Exporting AGForm-3D files (*.ag3) to a TIN file (*.TN3) allows you to open surface files in another program that recognizes TIN files, such as Topcon's 3D-Office or Pocket 3D.

1. Click **Field->Export topo surface->To 3D TIN file (*.TN3)** (Figure 2-48).

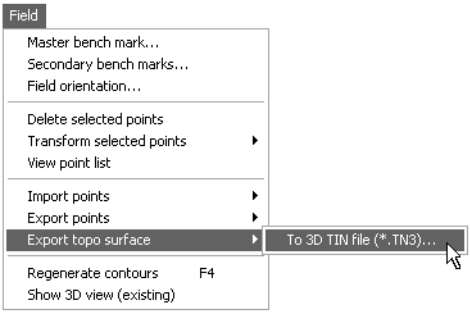


Figure 2-48. Export Topo Surface to a 3D TIN File

2. On the ***Save As*** dialog box, type a name for the TIN surface file and click **Save** (Figure 2-49).

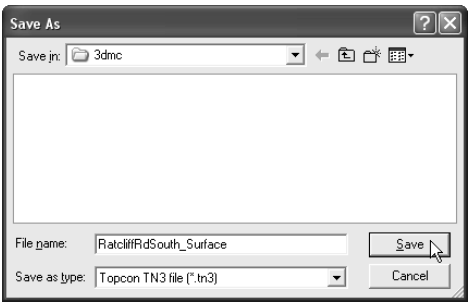


Figure 2-49. Enter TIN Surface File Name

AGForm-3D exports the surface file.

Regenerating Contours

Contour generation creates a TIN (Triangulated Irregular Network) model of the existing topographic surface. This TIN model must exist in the project before performing any design work; therefore, you must execute the regenerate contours function at least once. In fact, this routine only needs to be run once, unless the data has changed. The contours must be regenerated in order to update the TIN model in the following situations:

- points have been deleted or edited via the ***point list*** view. If using the Design View to delete points, the contours regenerate automatically.
- points have been altered by any one of the rotation or translation routines.

In order to properly form a TIN model, the perimeter must be closed (see “Joining Perimeter Lines” on page 4-3). If the perimeter is not closed, AGForm-3D will ask to use a convex hull for the perimeter. A convex hull is a mathematical entity used for bordering data sets, and has certain properties that may not be desirable for use as a perimeter. On a nearly square or rectangular field, the convex hull may work nicely as a perimeter. But for other field configurations, defining the perimeter through a survey, or by properly identifying records in an imported data file, might be more appropriate.

Finally, the regenerate contours function supports breaklines in the data set. Breaklines are typically used to define ridges and gulleys in a field survey. Defining such features as a breakline (a line at which the grade breaks) helps to make the TIN model more accurate.

To regenerate the contours of the field, click **Field->Regenerate Contours** or press **F4** (Figure 2-50).

Figure 2-50. Regenerate Contours

The contours of the field regenerate (Figure 2-51).

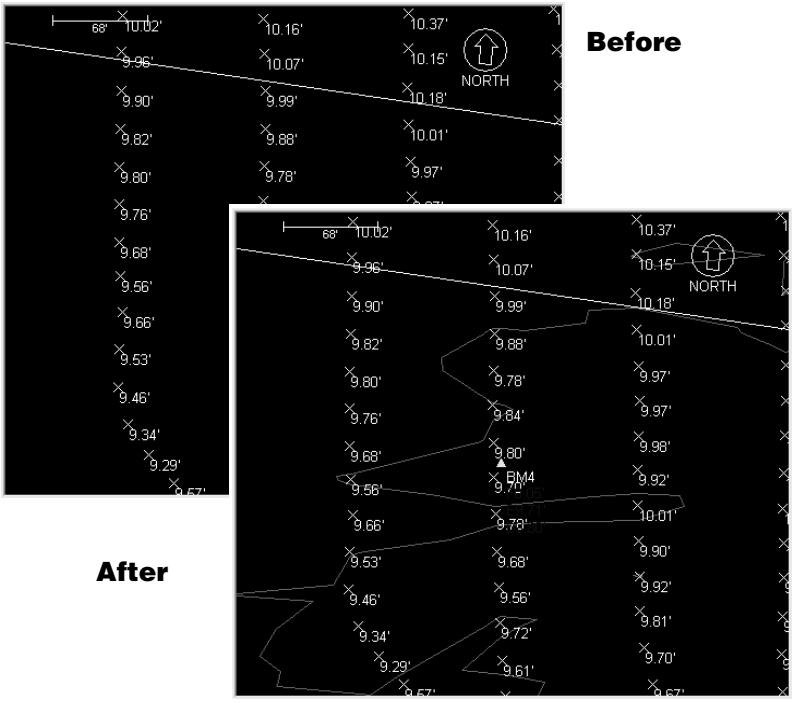


Figure 2-51. Regenerated Field Contours

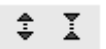
Displaying a 3D View of the Existing Surface

The 3D views in AGForm-3D use lines and colors to give a three-dimensional perception of a field on a two-dimensional screen. The 3D views provide a way to help you visualize the field (or lay of the land) in preparation for placing section breaks.

1. Click **Field->Show 3D view (existing)** (Figure 2-52).

Figure 2-52. Show 3D View for Existing Surface

2. On the ***3D view*** dialog box (Figure 2-53 on page 2-33), click the buttons on the toolbar to:

   - zoom in or out ( )
   - rotate left, right, down, or up ( )
   - exaggerate or decrease the vertical scale ()

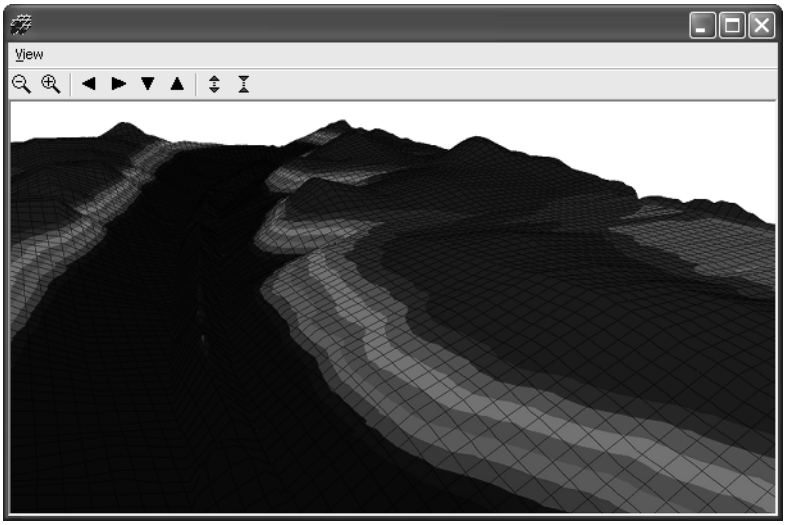


Figure 2-53. Existing Surface 3D View

Notes:

Working with Field Designs

This chapter describes field design and design surface management, including:

- creating, managing, merging, and deleting field sections
- exporting a plane surface
- displaying a 3-dimensional view of the design surface
- viewing a summary of the field and design surface

Creating a Single Section

A single section is the starting point for field design work. The single section function in AGForm-3D creates a plane that passes through the existing topographic surface. This plane becomes the design surface for grading work.

When creating the plane, you can:

- allow AGForm-3D to compute a best fit (minimum volume) plane, or manually specify the slopes of the plane
- specify a cut/fill ratio and import/export quantities
- optionally constrain the plane to pass through a specific point

For many fields, a single section may be all that is needed to generate the final design surface.

Best-fit Section

A best-fit section computation creates a single planar surface that will produce the least amount of earth to move based on the specified cut/fill ratio and import/export quantities.

A best-fit design computation is often a good starting point for a user-customized design. The plane parameters (slopes and point on surface) can easily be modified after completing a best-fit computation.

1. Click **Design->Single section entire field** (Figure 3-1).

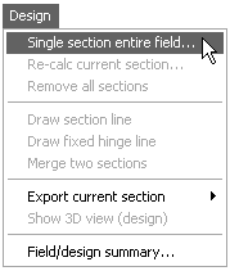


Figure 3-1. Design a Single Section Field

2. On the ***Section design*** dialog box and the *Best-fit* tab, enter the desired parameters and click **OK** (Figure 3-2 on page 3-3):

   - enter the direction of fall for slope 1

     Note: this value will not influence the computation of the plane, but rather specifies the directions along which the plane slopes will be reported.

   - enter the amount of extra volume to import or export
   - enter a cut/fill ratio

   The amount of time taken to compute the best-fit plane depends on the size and lay of the field and the number of data points.

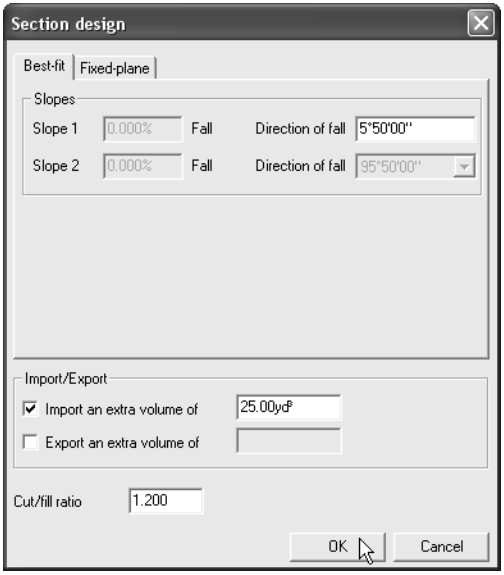


Figure 3-2. Surface Design – Best Fit

The Tab and Design Views update with the new section and design information (Figure 3-3 on page 3-4).

- In the Design View, the perimeter becomes a sold white border.
- In the Tab View, the *Section* pane displays section information, cut/fill values, import/export volumes, slopes, etc.

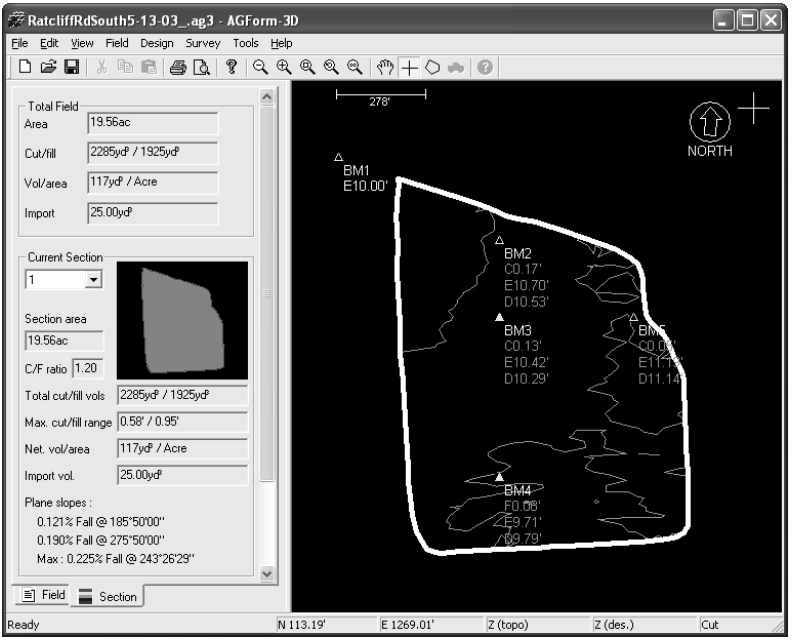


Figure 3-3. Single Section Design with Cut/Fill Contours

Fixed-plane Section

The fixed-plane computation provides full control over the parameters of the plane (slopes and point on surface). The computation also considers the import/export quantities and the cut/fill ratio. Optionally, a point on the surface of the plane can be specified. However, if slopes and a point on the surface are specified, the plane is completely determined, and the import/export and cut/fill parameters are no longer available. If only the slopes are specified, the plane translates vertically until the specified cut/fill ratio has been satisfied.

1. Click **Design->Single section entire field** (Figure 3-4).

Figure 3-4. Design a Single Section Field

2. On the ***Section design*** dialog box and the *Fixed-plane* tab, enter the desired parameters and click **OK** (Figure 3-5 on page 3-6):
   - enter desired slope percentages for slope 1 and slope 2
   - enter the direction of fall for slope 1 and select the direction of fall for slope 2.
   - optionally, set the coordinates for a fixed elevation point on the plane (unavailable if importing or exporting extra volume)
     For example, if building a road or pad at a specified elevation, create a section to represent the road or pad, then “force” the plane to pass through the desired point.

- enter the amount of extra volume to import or export (unavailable if setting a fixed elevation point)
- enter a cut/fill ratio (unavailable if setting a fixed elevation point)

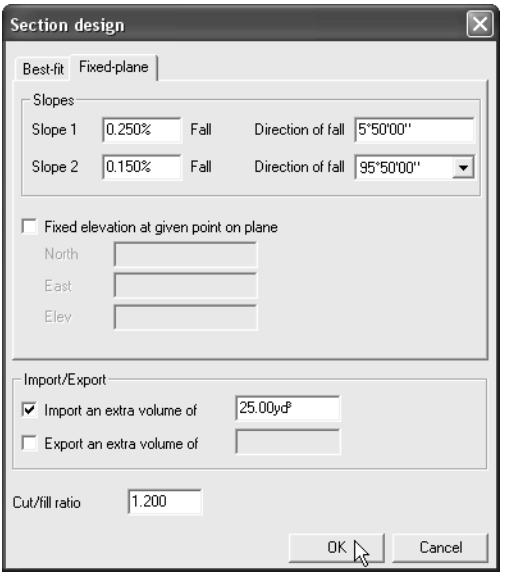


Figure 3-5. Section Design – Fixed Plane

The Tab and Design Views update with the new section and design information (Figure 3-6 on page 3-7).

- In the Design View, the perimeter becomes a sold white border.
- In the Tab View, the *Section* pane appears, displaying section information, cut/fill values, import/export volumes, slopes, etc.

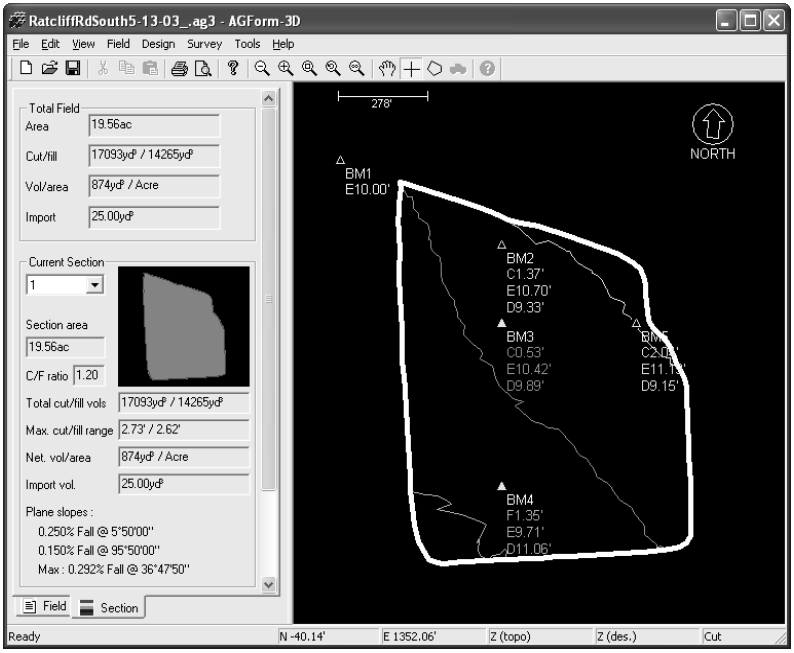


Figure 3-6. Single Section Design with Cut/Fill Contours

Creating and Merging Sections

In AGForm-3D, a field is the entire data set, and is typically bordered by a closed polygon called the perimeter. The field can be divided into sections for the purpose of creating different design surfaces over different regions of the field; for example, when a field is too large, or has too much variation in topography, to be graded to a single planar surface. Creating multiple sections can dramatically reduce the quantity of earth needed on a project, decreasing the cost of leveling and reducing the amount of topsoil cut. These multi-section fields can be directly imported into the AGS-100 control system for automated grading work. A field is easily subdivided by drawing subdivision lines in the Design View.

AGForm-3D has two types of subdivision lines: section lines and hinge lines. A section line permits a vertical step (bench) in the design surfaces (planes) between the two associated sections; whereas a hinge line ensures that the transition in the design surfaces occurs without a step. In the latter case, the sections are “hinged” together.

The work of subdividing a field can also be reversed, or undone, by merging adjacent sections with one another. Merging two sections removes the subdivision line between them, making one section out of two adjacent sections.

Creating a New Section

Before you can create multiple sections in a field, you must first create a single section of the entire field. See “Creating a Single Section” on page 3-1 for details on this procedure.

AGForm-3D considers each field section separately for earthwork calculation. Adjoining sections may be at different elevations (or terraced) and may have different slopes.

1. To create a section, click **Design->Draw section line** (Figure 3-7).

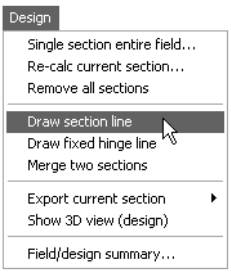


Figure 3-7. Draw Section Line

2. Using the Selection tool, point to the perimeter and click a red or green marker to define the starting point of the section line.
   - A red marker indicates that the starting point will snap to the nearest location on the perimeter.
   - A green marker means that the starting point will snap to one of the data points that define the perimeter.

   The starting point displays in a pop-up box (Figure 3-8).
3. Stretch the section line to the desired end point on the perimeter. To make “corners” in the section line, click at desired points on the field before clicking at the end point on the perimeter.

   The coordinates for the start and end points, and the bearing, display in a pop-up box (Figure 3-8).

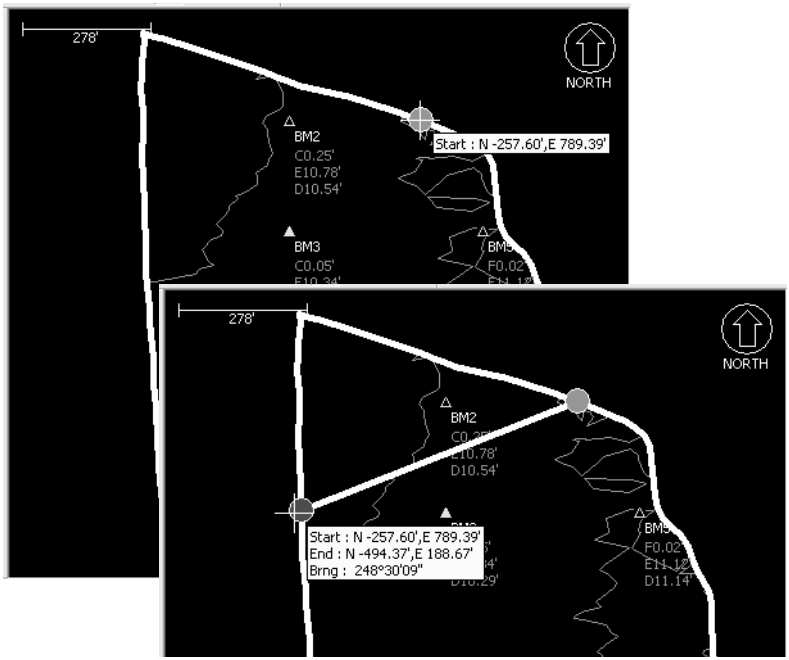


Figure 3-8. Draw Section Line

4. Click on the perimeter line to define the end point of the section line. The new section is selected and its information displays on the *Section* pane (Figure 3-9).

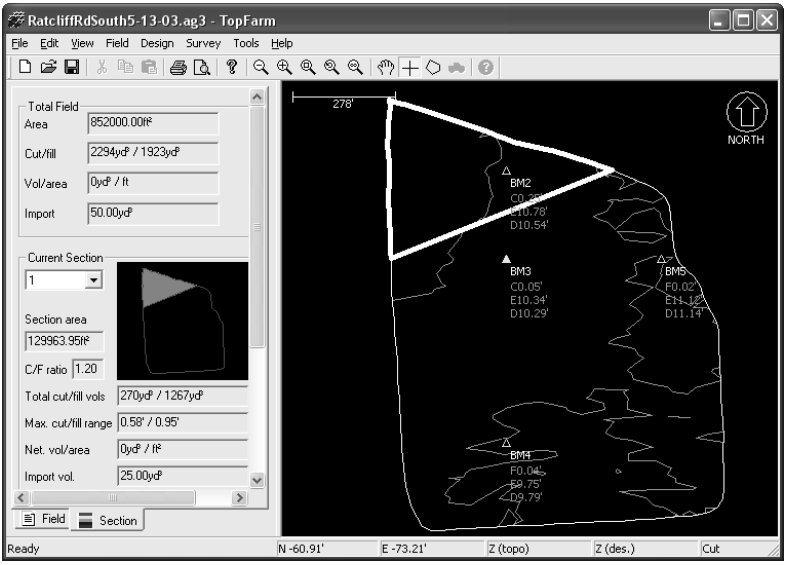


Figure 3-9. New Section

5. Repeat this procedure to further subdivide the field.

This procedure only draws a section line and computes the relative cut/fill volumes associated with each section. The design surface is not altered. Before continuing further design work, re-compute a new design surface for each section, if desired (see “Re-calculating a Section” on page 3-18).

Creating a Section with a Fixed Hinge Line

Hinge lines between sections are used when there can be no vertical step between adjacent sections. When a hinge line is drawn, the two associated design surfaces (planes) are created so their elevations match along the hinge line. Although the slopes perpendicular to the hinge line may be different in the adjoining sections, the slope of the section line that divides them is the same for both sections. Thus a hinge line, or "fold," is generated along the dividing section line. For this reason, hinged section lines must always be a straight line.

Before you can create multiple sections in a field, you must first make the field an entire section. See "Creating a Single Section" on page 3-1 for details on this procedure.

1. To create a section, click **Design->Draw fixed hinge line** (Figure 3-10).

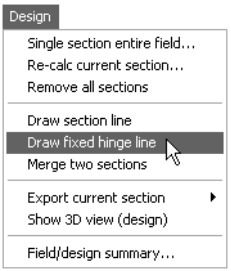


Figure 3-10. Draw Fixed Hinge Line

2. Using the Selection tool, point to the perimeter and click a red or green marker to define the starting point of the section line.
   - A red marker indicates that the starting point will snap to the nearest location on the perimeter.
   - A green marker means that the starting point will snap to one of the data points that define the perimeter.

   The coordinates for the starting point displays in a pop-up box.

3. Stretch the hinge line to the desired end point on the perimeter. A fixed hinge line displays as a dashed line. The coordinates for the start and end points, as well as the bearing, display in a pop-up box (Figure 3-11).

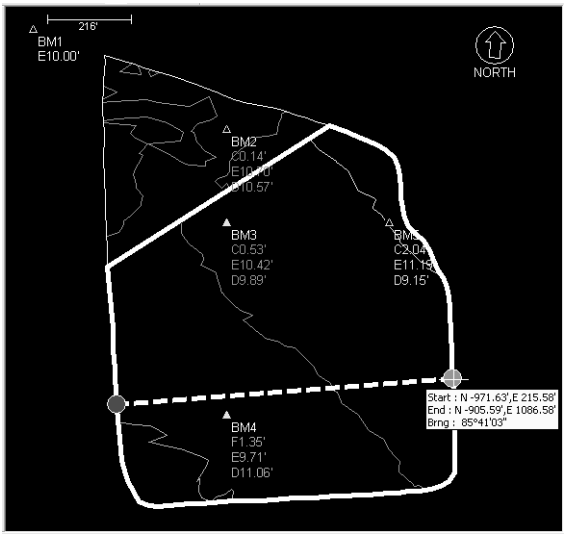


Figure 3-11. Draw Fixed Hinge Line

4. Click on the perimeter line to define the end point of the hinge line.

   Once the hinge line is drawn, AGForm-3D automatically computes the planes for the new section and displays the results on the ***Hinge design*** dialog box (Figure 3-12 on page 3-13). On this dialog box, you can customize the design planes to specified slope values.

   If one of the new sections is already bounded by a hinge line, the slopes of its design plane remain fixed as determined by the previous hinge line computation. In this case, both the slope of the fixed plane and the slope of the hinge line will appear grayed out in the ***Hinge design*** dialog box.

In the example in Figure 3-12, no existing hinge lines border the new sections, so all parameters are available. In this case, the slope grades, directions of the plane, and the slope of the hinge line can all be changed.

This procedure explains operating on only two sections at a time, but gives maximum control in manually defining design slopes. However, if three or more sections have been linked together with hinge lines, re-compute them at the same time, if desired (see “Re-calculating a Section” on page 3-18). This will typically result in overall lower earth quantities.

5. On the ***Hinge design*** dialog box, set the desired parameters and click **OK** (Figure 3-12).
   - Hinge line slope – the percentage of slope for the hinge line and its direction (Rise or Fall)
   - Left of line – the percentage of slope to the left of the hinge line (when standing at start point and looking towards end point) and its direction (Rise or Fall)
   - Right of line – the percentage of slope to the right of the hinge line (when standing at start point and looking towards end point) and its direction (Rise or Fall)

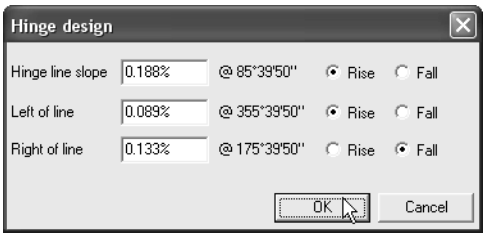


Figure 3-12. Set Hinge Line Parameters

The hinge line and new sections display in the Design View and *Section* pane (Figure 3-13).

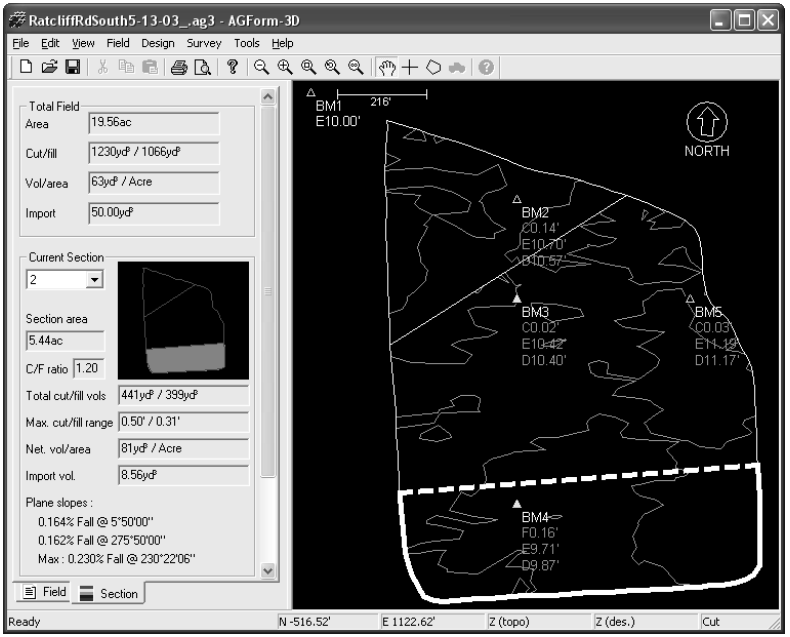


Figure 3-13. New Section by Hinge Line

6. Repeat this procedure to further subdivide the field with hinge lines.

Merging Two Sections

Merging two sections combines the information relative to those sections into one section. Essentially, a merge of two sections is the undoing of creating sections, thus deleting the section line between two adjoining sections.

1. Click **Design->Merge two sections** (Figure 3-14).

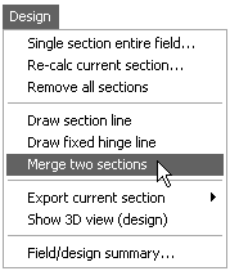


Figure 3-14. Merge Two Sections

2. With the Selection tool, click on the first section (Figure 3-15).

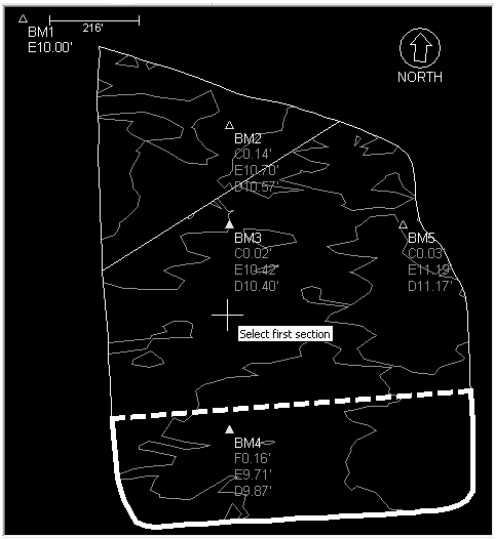


Figure 3-15. Select First Section

Once selected, the borders of the first section turn purple.

3. Click an adjacent section to merge with the first section (Figure 3-16).

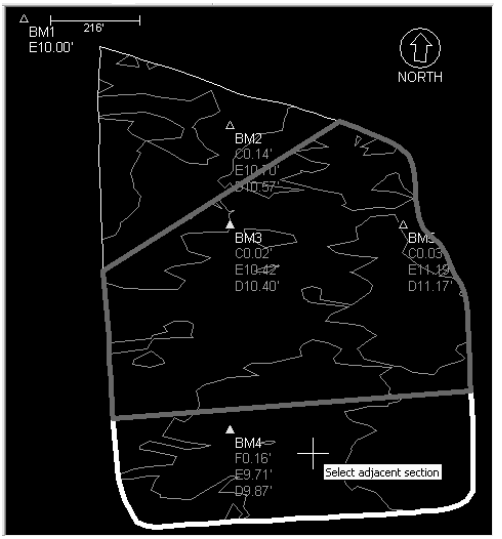


Figure 3-16. Select Adjacent Section

4. Click **OK** on the confirmation dialog box to complete the merge (Figure 3-17).

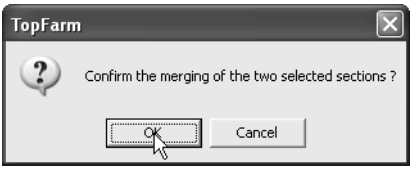


Figure 3-17. Confirm Merge

AGForm-3D calculates and combines the land area, cut/fill volumes, and cut/fill range of the two sections. Figure 3-18 on page 3-17 show the results after merging two sections. Notice that the cut/fill contours have been re-computed.

These new quantities are based on the definition of the pre-existing plane of the merged sections that had the lower section number. Run the re-calculate current section function to compute a best-fit or fixed plane that pertains to the newly merged section (see “Re-calculating a Section” on page 3-18).

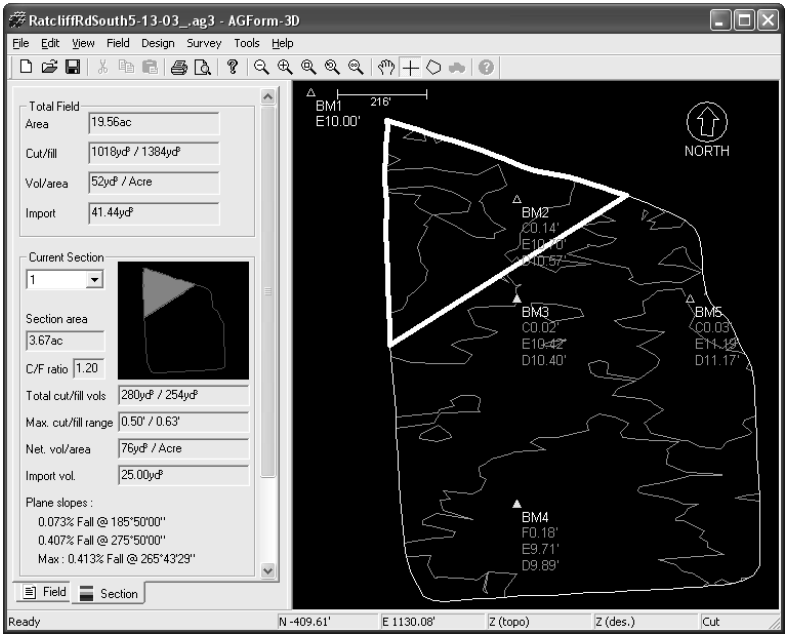


Figure 3-18. Merge of Two Sections Complete

Re-calculating a Section

After creating a section or merging sections, the re-calculate section function must be run in order to create or update the corresponding design surface.

1. If not already selected, select the desired section (Figure 3-19). Either click the section view of the *Section* pane, or right-click the section in the Design View and click **Set active section**.

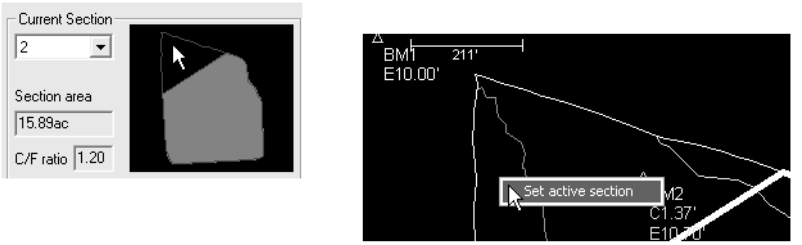


Figure 3-19. Select Desired Section

2. Click **Design->Re-calc current section** (Figure 3-20).

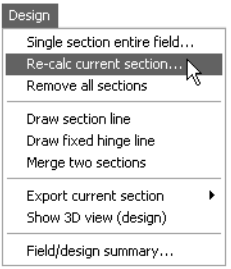


Figure 3-20. Re-calculate Current Section

3. On the ***Section design*** dialog box, do one of the following:
   - Click either the *Best-fit* or the *Fixed-plane* tab to select the method of calculation. For more information on these tabs, see “Creating a Single Section” on page 3-1.
   - If re-calculating a section with a hinge line, the *Hinged planes* tab displays on the ***Section design*** dialog box. The hinged line sections are listed in the upper region of the

dialog box. If necessary, modify the width of the columns to view hidden information. On the *Hinged planes* tab, enter the following parameters (Figure 3-21):

–if available, click **Edit Slopes** to edit the slope of the selected hinge line

–to simultaneously re-compute all sections linked by hinge lines, enable the corresponding check box

–enter the amount of extra volume to import or export

–enter a cut/fill ratio

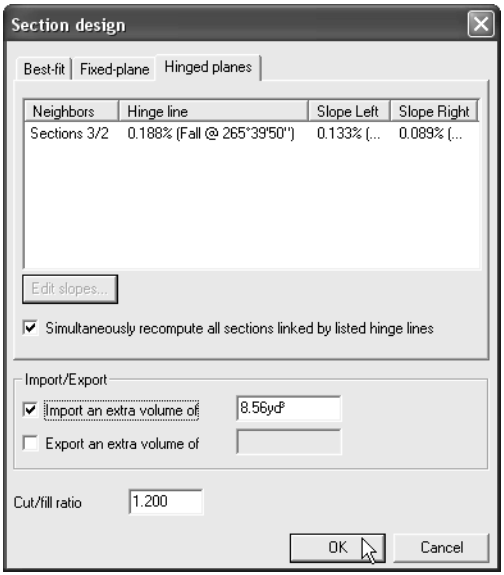


Figure 3-21. Section Design – Hinged Planes Tab

4. Click **OK** on the ***Section design*** dialog box. The Design View and *Section* pane update with the re-calculated information (Figure 3-22).

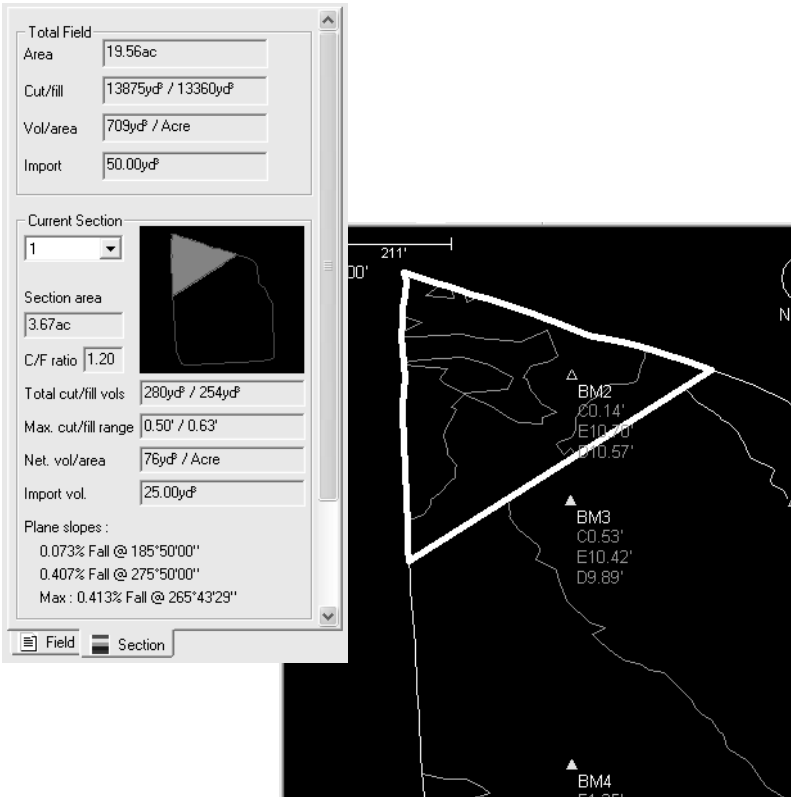


Figure 3-22. Re-calculated Section Pane and Design View Information

Exporting a Section to a 3D Plane File

The planar design surfaces created in AGForm-3D can be exported to a Topcon 3D Plane file (*.PL3), which can then be used in other Topcon programs.

1. Select the desired section. Either click the section view of the *Section* pane, or right-click the section in the Design View and click **Set active section** (Figure 3-23).

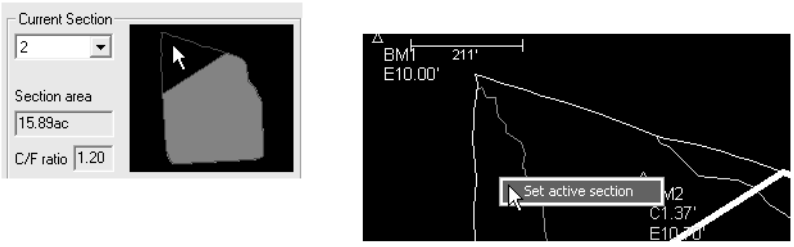


Figure 3-23. Select Desired Section

2. Click **Design->Export current section->To 3D plane file (*.PL3)** (Figure 3-24).

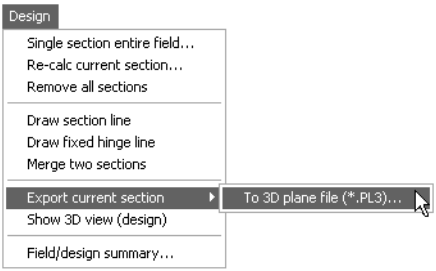


Figure 3-24. Export Section to a 3D Plane File

3. On the ***Save As*** dialog box, navigate to the folder in which to save the file, name the file, and click **Save** (Figure 3-25).

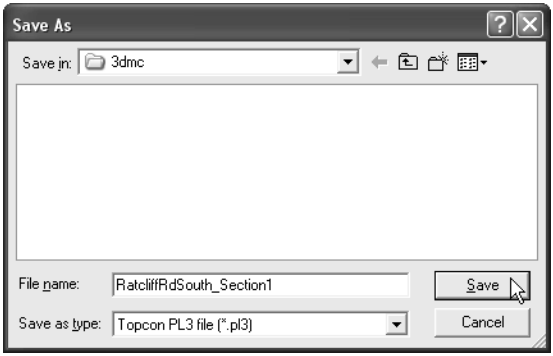


Figure 3-25. Save 3D Plane File

Displaying a 3D View for the Design Surface

The 3D views in AGForm-3D use lines and colors to give a three-dimensional perception of a field on a two-dimensional screen. Using the design surface 3D view will help to visualize what the field (lay of the land) looks like.

1. Click **Design->Show 3D view (design)** (Figure 3-26).

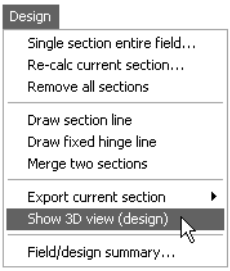


Figure 3-26. Show 3D Design View

2. On the ***3D view*** dialog box (Figure 3-27), click the buttons on the toolbar to:

   - zoom in or out ( )
   - rotate left, right, down, or up ( )
   - exaggerate or decrease the vertical scale ( )

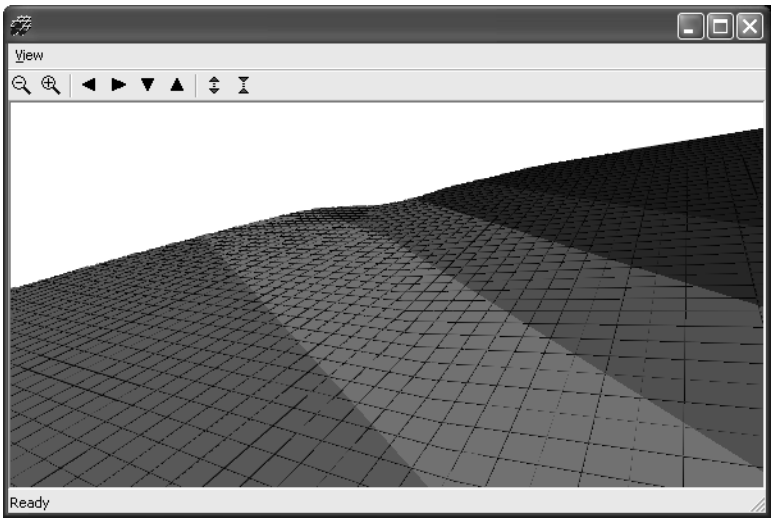


Figure 3-27. 3D View – Design

Field/Design Summary

The Field Design Summary displays individual section and total field information.

- The upper pane displays information in a tabular view that consist of areas, volumes, maximum/minimum cuts and fills, volume per acre, and import/export quantities. The lower pane displays benchmark data.
- The Print button generates a tabular print of the information along with a title block. The Save button writes the information to a user-specified file in ASCII format. The information written to file can be inserted into reports or attached to email.

To open the field design summary, click **Design->Field/design summary** (Figure 3-28).

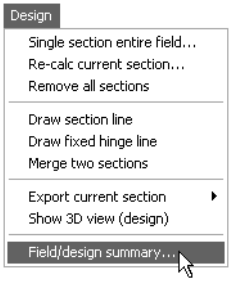


Figure 3-28. Open Field/design Summary

The ***Field summary*** dialog box opens (Figure 3-29).

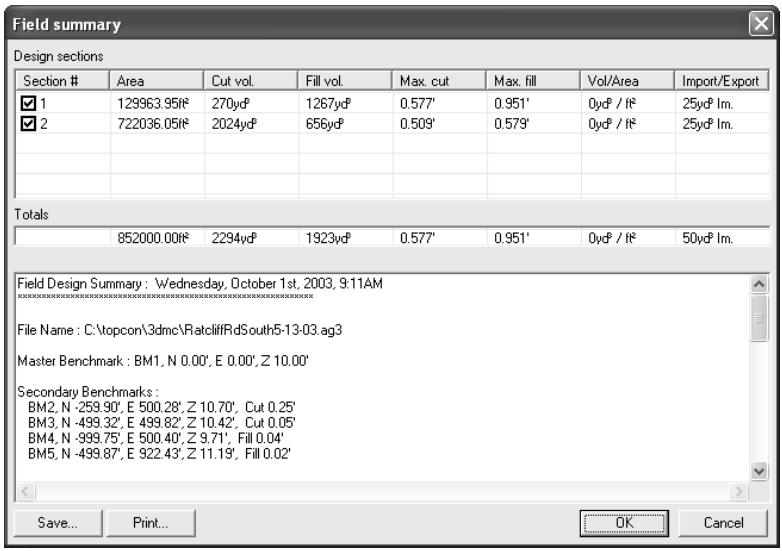

Field summary
Design sections
Section # | Area | Cut vol. | Fill vol. | Max. cut | Max. fill | Vol/Area | Import/Export
1 | 129963.95ft² | 270yd³ | 1267yd³ | 0.577' | 0.951' | 0yd³ / ft² | 25yd³ Im.
2 | 722036.05ft² | 2024yd³ | 656yd³ | 0.509' | 0.579' | 0yd³ / ft² | 25yd³ Im.
Totals
852000.00ft² | 2294yd³ | 1923yd³ | 0.577' | 0.951' | 0yd³ / ft² | 50yd³ Im.
Field Design Summary : Wednesday, October 1st, 2003, 9:11AM
File Name : C:\topcon\3dmc\RatcliffRdSouth5-13-03.ag3
Master Benchmark : BM1, N 0.00', E 0.00', Z 10.00'
Secondary Benchmarks :
BM2, N -259.90', E 500.28', Z 10.70', Cut 0.25'
BM3, N -499.32', E 499.82', Z 10.42', Cut 0.05'
BM4, N -999.75', E 500.40', Z 9.71', Fill 0.04'
BM5, N -499.87', E 922.43', Z 11.19', Fill 0.02'
Save...
Print...
OK
Cancel

Figure 3-29. Field Summary

The ***Field summary*** dialog box has three areas that contain information about the field and design.

- Design sections – displays a row of information for each section in the field (Figure 3-30 on page 3-26).

  –Section #: lists each section by number. Select the box to include that section's information in the totals calculated below.

  –Area: total area for the section

  –Cut vol: total cut volume for the section

  –Fill vol: total fill volume for the section

  –Max cut: maximum cut for the section

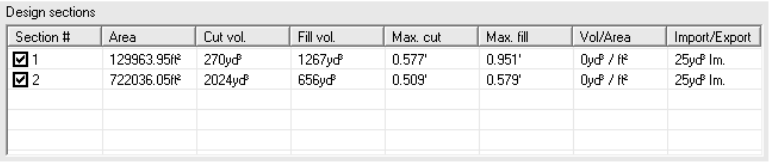
  –Max fill: maximum fill for the section

  –Vol/Area: total volume per area for the section

–Import/Export: total import/export volume for the section (Im = import; Ex = export)

TIP

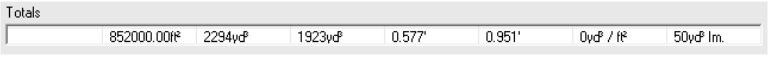
To see quantities listed in other units, change the units in the Options dialog box as described in “Units Options” on page 4-23.


Design sections

Section #	Area	Cut vol.	Fill vol.	Max. cut	Max. fill	Vol/Area	Import/Export
☑ 1	129963.95ft²	270yd³	1267yd³	0.577'	0.951'	0yd³ / ft²	25yd³ Im.
☑ 2	722036.05ft²	2024yd³	656yd³	0.509'	0.579'	0yd³ / ft²	25yd³ Im.

Figure 3-30. Section Design Information

- Totals – displays totals for selected sections (Figure 3-31).


Totals

	852000.00ft²	2294yd³	1923yd³	0.577'	0.951'	0yd³ / ft²	50yd³ Im.

Figure 3-31. Total for Selected Sections

- Field Design Summary – displays field and design information (Figure 3-32 on page 3-27), and can be saved as a text file:

  –File Name: the disk location and name of the project file

  –Benchmarks: shows cuts and fills on the benchmarks that lie within the design surface

  –Total field area

  –Section information: displays each section’s area, cut/fill volumes, maximum cut/fill volumes, volume/area, import/export volume, and slopes

–Section totals: displays the total area, cut/fill volumes, maximum cut/fill volumes, volume/area, and import/export volume totals for selected sections

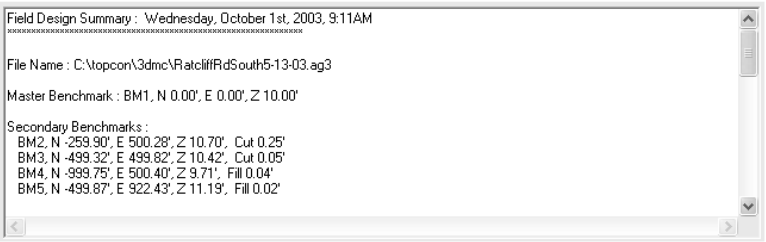

Field Design Summary : Wednesday, October 1st, 2003, 9:11AM
File Name : C:\topcon\3dmc\RatcliffRdSouth5-13-03.ag3
Master Benchmark : BM1, N 0.00', E 0.00', Z 10.00'
Secondary Benchmarks :
BM2, N -259.90', E 500.28', Z 10.70', Cut 0.25'
BM3, N -499.32', E 499.82', Z 10.42', Cut 0.05'
BM4, N -999.75', E 500.40', Z 9.71', Fill 0.04'
BM5, N -499.87', E 922.43', Z 11.19', Fill 0.02'

Figure 3-32. Field Design Summary

Saving the Field Summary

1. To save the *Field Design Summary* area as a text file, click **Save** on the ***Field summary*** dialog box.
2. On the ***Save As*** dialog box, navigate to the folder in which to save the file, enter a name, and click **Save** (Figure 3-33).

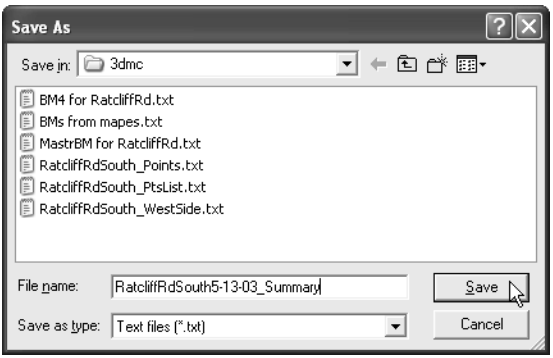


Figure 3-33. Save Field Summary

Printing the Field Summary

TIP

See “Print Setup” on page 1-27 for changing title block information.

1. To print the field summary, click **Print** on the ***Field summary*** dialog box.
2. On the ***Print*** dialog box, select the desired settings and click **Print**.

A printed field summary has the following (Figure 3-34):

- *Design sections* and *Totals* of the ***Field summary*** dialog box.
- Bench mark information of the ***Field summary*** dialog box.
- Title block area that includes the project name, file location, date and time of printing, and comments.

Section #	Area	Cut vol.	Fill vol.	Max. cut	Max. fill	Vol/Area	Im./Ex.	Slope 1 :	Slope 2 :
1	3.67ac	280yd³	254yd³	0.501'	0.633'	76yd³/Ac	25yd³ Im.	0.073% Fall@185°50'00"	0.407% Fall@275°50'00"
2	5.44ac	441yd³	399yd³	0.499'	0.315'	81yd³/Ac	9yd³ Im.	0.164% Fall@5°50'00"	0.162% Fall@275°50'00"
3	10.45ac	509yd³	413yd³	0.327'	0.337'	49yd³/Ac	16yd³ Im.	0.121% Fall@5°50'00"	0.169% Fall@275°50'00"
Totals:	19.56ac	1230yd³	1066yd³	0.501'	0.633'	63yd³/Ac	50yd³ Im.		

Master Benchmark : BM1, N 0.00', E 0.00', Z 10.00'

Secondary Benchmarks :
BM1, N 0.00', E 0.00', Z 10.00'
BM2, N -259.90', E 500.28', Z 10.70', Cut 0.14'
BM3, N -499.32', E 499.82', Z 10.42', Cut 0.02'
BM4, N -999.75', E 500.40', Z 9.71', Fill 0.16'
BM5, N -499.87', E 922.43', Z 11.19', Cut 0.03'

TPS

Comment :This is an example

C:\topcon\3dmc\RatcliffRdSouth5-13-03_ag3

12/09/2003

Figure 3-34. Example Field Summary Print Results

Field Tools

This chapter describes some common tools used to view and manage field information, including:

- measuring distances and areas
- joining perimeter lines
- viewing and printing a profile of the field
- calculating volumes of selected areas
- real-time distance measuring with GPS
- viewing and changing options for the field, antenna, radio, survey, and units of measure

Measuring a Selected Distance/Area

This tool computes distances between points and areas of polygons. For example, this tool can be used to determine the length of a road built adjacent to the field, or to measure the area of a portion of the field to be graded.

1. Click **Tools->Measure distance/area**. A check mark displays next to the menu option (Figure 4-1).

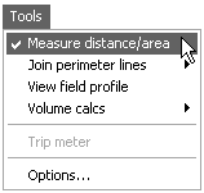


Figure 4-1. Measure Distance/area

The polygon cursor is automatically selected and a pop-up box displays running length and area information (Figure 4-2).

Figure 4-2. Polygon Cursor and Pop-up Information Box

2. Click at the desired point to begin the measurement. Move the crosshairs to the next point and click. Continue in this manner until the desired area has been selected with a polygon (Figure 4-3).

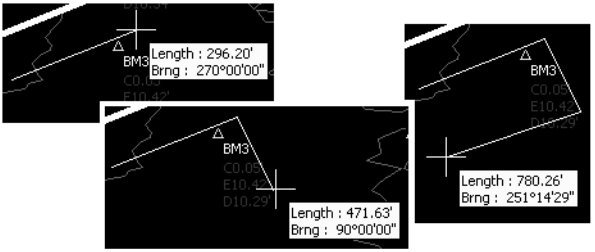


Figure 4-3. Draw Polygon

3. To close the polygon, click on the start point. When the crosshairs reach the starting point, the lines of the polygon thicken and the pop-up box displays the total length and area enclosed within the polygon (Figure 4-4).

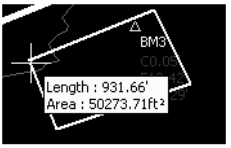


Figure 4-4. Distance/Area Measurement Polygon Complete

4. To quit this function, click **Tools->Measure distance/area** and remove the check mark from the menu option, or press the **Esc** key on the keyboard.

Joining Perimeter Lines

Depending on field conditions, it may not be possible to conduct a perimeter survey in a manner that creates a closed polygon for the perimeter; the perimeter may have one or several breaks. In this case, the perimeter must be properly closed before the topographic TIN model can be generated.

The perimeter tools provide a choice between automatic and manual perimeter closure. The automatic mode works by connecting the ends of perimeter polylines to their closest neighbor. This approach will often be satisfactory, but sometimes the connections must be defined manually in order to get the proper linkage. The following sections describe both methods.

Automatically Join Perimeter Lines

To automatically join perimeter lines, click **Tools->Join perimeter lines->Automatic** (Figure 4-5).

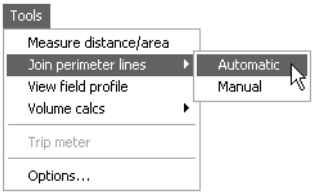


Figure 4-5. Automatically Join Perimeter Lines

The lines of the perimeter join (Figure 4-6).

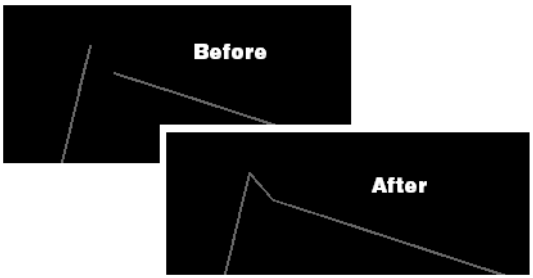


Figure 4-6. Perimeter Lines Joined

Manually Join Perimeter Lines

1. To manually join perimeter lines, click **Tools->Join perimeter lines->Manual** (Figure 4-7).

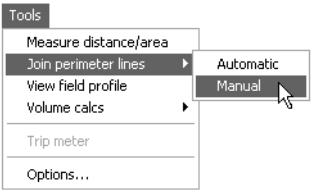


Figure 4-7. Manually Join Perimeter Lines

The Select tool is activated, red markers appear at the ends of the perimeter lines, and an instructional pop-up box displays (Figure 4-8).

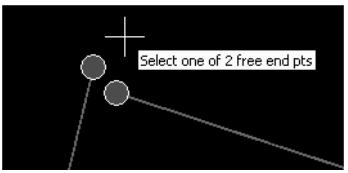


Figure 4-8. Ready to Select End Point

2. Select one of the end points; a green marker replaces the red marker and the pop-up box displays the coordinates of the selected point (Figure 4-9).
3. Select the second end point; a green marker replaces the red marker and a pop-up box displays the start and end point coordinates (Figure 4-9).

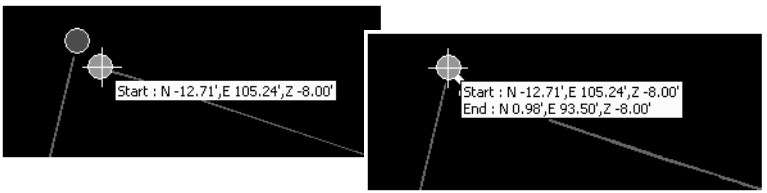


Figure 4-9. Select End Points

The lines of the perimeter join (Figure 4-6 on page 4-3).

Viewing Field Profiles

The Profile View is a powerful tool for visualizing cut and fill amounts along a line through the filed and can be used to:

- check clearances between the design surface and existing gas lines, or other utility lines, of known depth
- view the step height between sections

The profile can be viewed statically or dynamically by dragging the profile line across the field.

1. To view a profile of the field, click **Tools->View field profile**. A check mark displays next to the menu option (Figure 4-10).

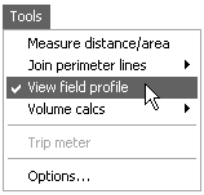


Figure 4-10. View Field Profile

2. In the Design View, click a point at which to begin the profile.
3. Stretch the line across the field and click once to end it (Figure 4-11).

Figure 4-11. Select Area to View in Profile

The ***3D view*** displays (Figure 4-12) the following information:

- elevation tic marks on the left of the view window
- a profile of the field: the design surface is in white, the topography surface is in green
- a pop-up box showing the northing and easting coordinates, the existing and design elevations, and the existing and design grades at the point of the crosshair
- a horizontal scale bar
- NEZ position in the status bar

  The vertical scale is shown as a ratio next to the elevation in the status bar on the far right.

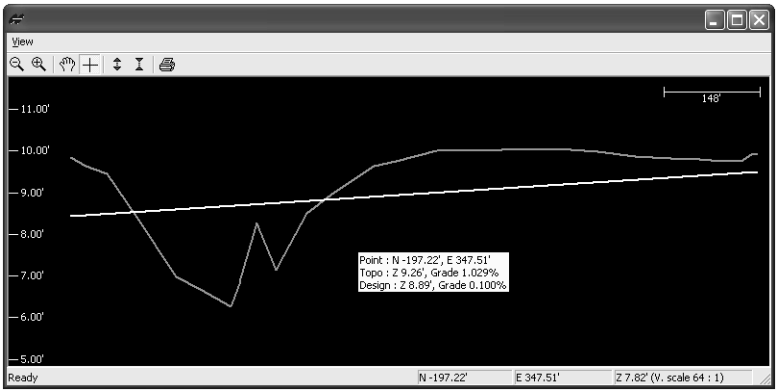


Figure 4-12. Profile View

4. On the ***3D view*** dialog box (Figure 4-12), click the buttons on the toolbar to:

   - zoom in or out ( )
   - pan ( )
   - view Point, Topo, and Design information at the cross hair location in the ***view*** dialog box ( )

- exaggerate or decrease the vertical scale ( )
- print the profile view ( )

When printing, print with a landscape orientation for better placement of the Profile View on paper.

5. Leaving the ***3D view*** dialog box open, click, “grab” and “drag” the start or end point of the profile line in the Design View to a new position. The “grabbed” point is green while being manipulated. The Profile View changes accordingly.

   Or, you can grab the line and shift it without changing its direction or length.

If you close the view, you must quit the profile function (press Esc), then repeat steps1 through 3 on page 4-5 to display the dialog box again.

6. To quit this function, click **Tools->View field profile** and remove the check mark from the menu option, or press **Esc** once to close the view, and a second time to remove the profile line.

Calculating Volumes

AGForm-3D provides two volume computation routines: Basic Volume calculation and Subregion Volume calculation.

Calculating Basic Volumes

The Basic Volume calculation computes the product of designated length, width, and height quantities. The length is defined by drawing a line in the Design View; the other variables are entered via a dialog box.

For example, use the Basic Volume calculation to determine the volume of earth needed to construct a road along the perimeter of a field.

1. Click **Tools->Volume calcs->Basic volume calc** (Figure 4-13).

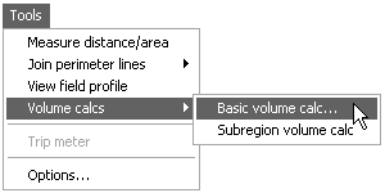


Figure 4-13. Basic Volume Calculation

2. In the Design View, click on a starting point. Move the cursor to the end point and click (Figure 4-14).

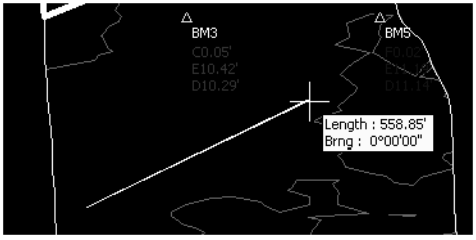


Figure 4-14. Select Area to Calculate

3. On the ***Basic Volume Calc*** dialog box, enter a width and height (Figure 4-15).

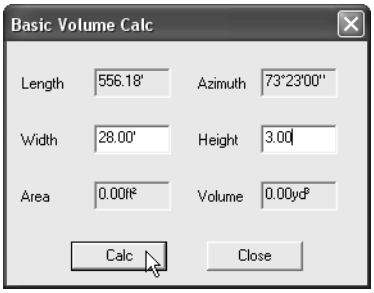


Figure 4-15. Enter Width and Height

4. Click **Calc**. The ***Basic Volume Calc*** dialog box updates with the calculated area and volume of the selected area (Figure 4-16).

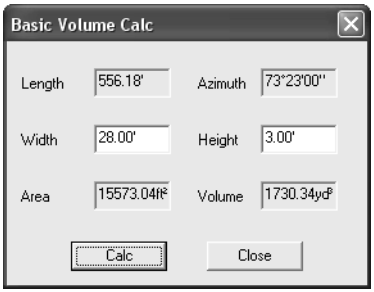


Figure 4-16. Calculated Area and Volume

TIP

All values in the Basic Volume Calc dialog can be selected for copying and pasting to a text editor.

Calculating Subregion Volumes

The Subregion Volume calculation is a powerful tool that allows you to trace out subregions of the field for computing cut and fill volumes in the subregion.

The Subregion Volume calculation can be used to monitor the grading operation or to verify assumed cut-to-fill ratios by evaluating the grading in a subregion of the field. It can easily be used to trace around a cut or fill region to ascertain the quantity of material in that region.

1. Click **Tools->Volume calcs->Subregion volume calc** (Figure 4-17).

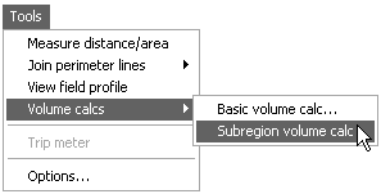


Figure 4-17. Subregion Volume Calculation

2. In the Design View, click on a starting point. Move the cursor to the end point and click (Figure 4-18 on page 4-11).

TIP

When using a portion of the field perimeter as the subregion border, draw along the perimeter on the outside of the field.

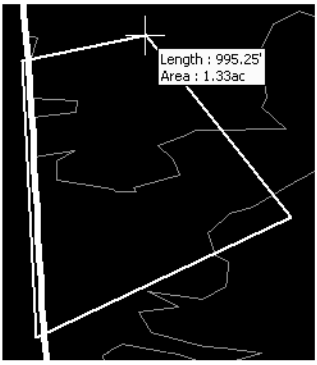


Figure 4-18. Select Area to Calculate

3. The ***Subregion Volume Results*** dialog box displays the following information for the selected subregion (Figure 4-19 on page 4-12):
    - User-specified cut/fill ratio – specified at the time the section was created
    - Import/export volume – this volume is a proportion of the total import/export volume of the field/section based on the area of the subregion
    - Sub-region area within the field
    - Cut volume
    - Fill volume
    - Cut/fill ratio without import/export – could be zero or blank if no cut or no fill
    - Cut/fill ratio with import/export – could be zero or blank if no cut or no fill

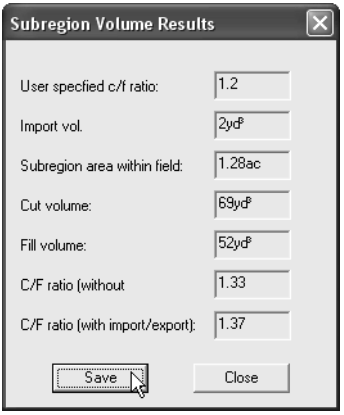


Figure 4-19. Subregion Volume Results

4. To save this information, click **Save** on the ***Subregion Volume Results*** dialog box (Figure 4-19).
5. On the ***Save As*** dialog box, navigate to the location in which to save the file and enter a name for the file. Click **Save** to save the subregion volume results as a text (.txt) file (Figure 4-20).

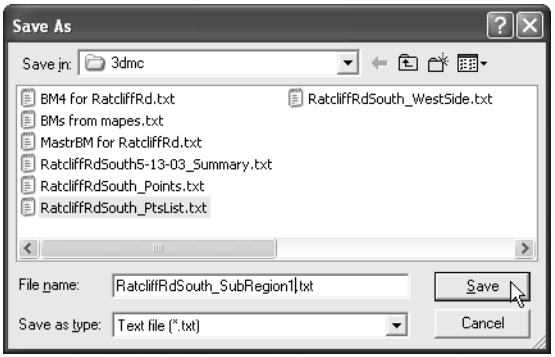


Figure 4-20. Save Subregion Results as a Text File

Using the Trip Meter

The trip meter is used to measure a running distance from a starting point. This tool requires that the GPS receiver be connected and initialized (see “Connecting to the Receiver” on page 5-7).

To start the trip meter, click **Tools->Trip meter** (Figure 4-21).

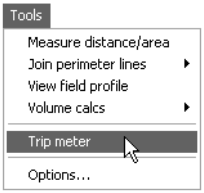


Figure 4-21. Start Trip Meter

The ***Trip Meter*** dialog box has the following fields (Figure 4-22):

- Running distance – the distance covered since starting the trip meter. Click **Reset** to set the distance at zero.
- Point-to-point – the measured distance, the current angular units, and the percentage of grade between two points. See “Measuring the Distance, Direction, and Grade Between Two Points” on page 4-14 for details.

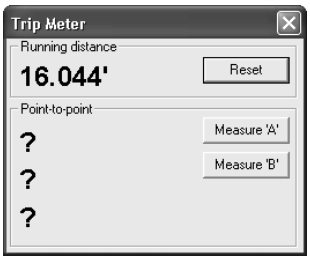


Figure 4-22. Trip Meter Dialog Box

The *Running distance* and *Point-to-point* quantities may vary by a small amount, even after pressing **Reset**. The running distance is a summation of all the incremental distances along the route, whereas the point-to-point represents an inverse between the starting and ending point coordinates.

Measuring the Distance, Direction, and Grade Between Two Points

The Trip Meter function also measures the distance, angle, and grade between two points (Figure 4-23). This tool requires that the GPS receiver be connected and initialized (see “Connecting to the Receiver” on page 5-7 for details).

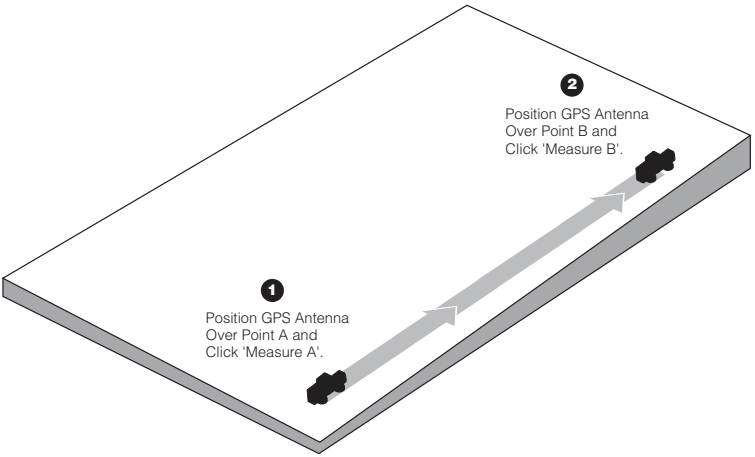


Figure 4-23. Measuring the Distance Between Two Points

1. Navigate to the desired point (Point A) from which to begin the measurement. See “Navigating to a Point” on page 5-29 to use GPS coordinates for the point.
2. Once at Point A, click **Tools->Trip meter** (Figure 4-24).

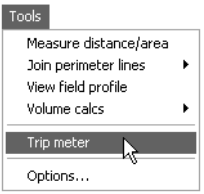


Figure 4-24. Start Trip Meter

3. On the ***Trip Meter*** dialog box, click **Reset** to set the *Running distance* to zero, if desired.

4. Click '**Measure A'** to measure the first point (Figure 4-25).

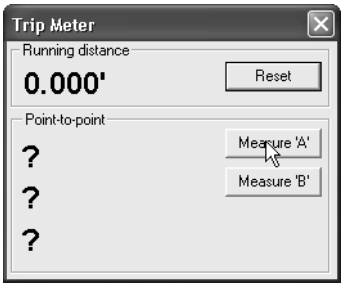


Figure 4-25. Measure the First Point

5. Drive to the second point (Point B) and position the GPS antenna over the point (Figure 4-23 on page 4-14). The *Running distance* continuously updates with the distance covered during the trip.
6. At Point B, click **'Measure B'**. The ***Trip Meter*** dialog box updates with the measured distance, the angle, and the grade between Point A and Point B (Figure 4-26).

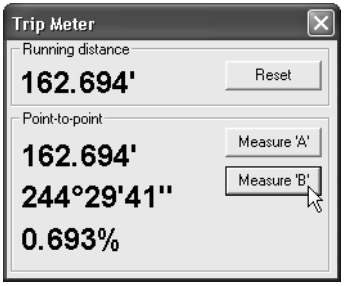


Figure 4-26. Point-to-point Measurement Information

- The Running distance may be different than the distance between Point A and Point B (point-to-point). See page 4-13 for more details.
- Continue driving to measure the distance between another point and Point A. Simply click **'Measure B'** once over the desired point; the ***Trip Meter*** dialog box updates.

Viewing and Changing Options

AGForm-3D options define Design View grid and contour parameters, GPS antenna, radio, survey and connection settings, and sets the units for the project.

To view or change options, click **Tools->Options**. The ***Options*** dialog box displays (Figure 4-27). See the following sections for more information on the Options tabs.

- “Field Options” on page 4-17
- “Antenna Options” on page 4-18
- “Radios Options” on page 4-19
- “Survey Options” on page 4-21
- “Connection Options” on page 4-22
- “Units Options” on page 4-23

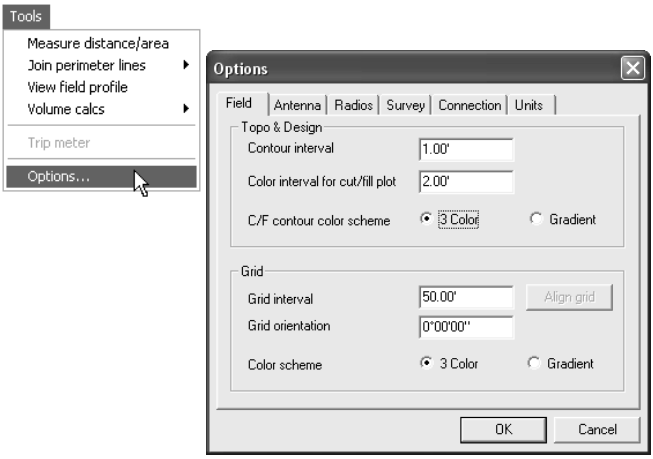


Figure 4-27. Open Options Dialog Box

Field Options

The *Field* tab displays the following information (Figure 4-28 on page 4-18):

- Topo & Design – This section of the tab sets properties for existing and design contours. The unit of measurement depends on the Units setting (see "Units Options" on page 4-23).

  –Contour interval: the spacing of the contours as seen in the Design View

  –Contour interval for cut/fill plot: the spacing of the cut/fill contours for the plot in the Design View

  –C/F contour color scheme: the color of the cut/fill contour lines.
  The three-color scheme renders cut as red, fill as blue, and grade as green. The gradient spreads the range of cut to fill across the full color-spectrum.

- Grid – This section of the tab sets grid display properties. The unit of measurement depends on the Units setting (see "Units Options" on page 4-23).

  –Grid interval: sets the spacing between grid lines

  –Align grid: aligns the grid origin to the location of the GPS antenna when connected to an initialized GPS system

  –Grid orientation: rotates the grid without changing the coordinates of the points
  Grid orientation is independent of the Field Orientation (see "Field Orientation" on page 2-9).

  –Color scheme: the color of the grid lines
  The three-color scheme renders cut as red, fill as blue, and grade as green. The gradient spreads the range of cut to fill across the full color-spectrum.

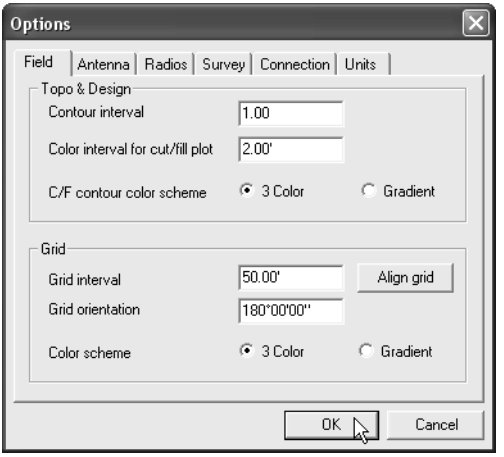


Figure 4-28. Options Dialog Box – Field Tab

Click **OK** to save the selected parameters and close the ***Options*** dialog box. Or click another tab to view or make changes on the ***Options*** dialog box.

Antenna Options

The *Antenna* tab displays the following information (Figure 4-29 on page 4-19):

- Antenna type – select the GPS antenna type
- Antenna height (to base of antenna) – enter the height measured from the bottom of the pole/scraper to the base of the antenna
  The unit of measurement depends on the Units setting (see "Units Options" on page 4-23).
- Minimum satellite mask angle – enter a mask angle in degrees
  The default angle is 10°.

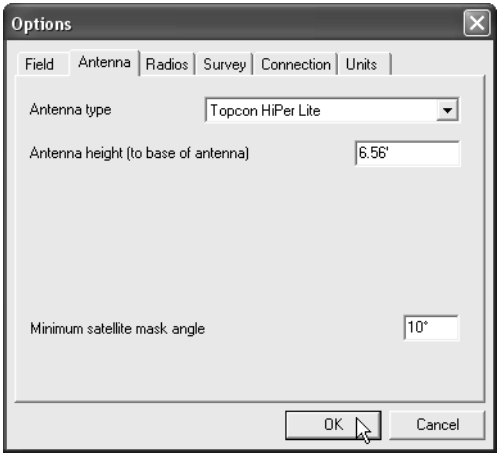


Figure 4-29. Options Dialog Box – Antenna Tab

Click **OK** to save the selected parameters and close the ***Options*** dialog box. Or click another tab to view or make changes on the ***Options*** dialog box.

Radios Options

To configure radio parameters, connect AGForm-3D to a GPS receiver (see "Connecting to the Receiver" on page 5-7). The *Radios* tab displays the following information (Figure 4-30 on page 4-20):

- Radio type – select the type of radio used; for the HiPer® Lite system, select Internal Spread Spectrum
- Data format – select the type of format (typically CMR)
- Rover – sets radio information for the Rover; used when AGForm-3D connects to a receiver

  –Radio port: select the radio port; for spread spectrum radios, select Port C

  –Port baud rate: select the baud rate for the radio; for spread spectrum radios, select 38400

- Base – sets radio information for the Base; used when AGForm-3D connect to a receiver

  –Radio port: select the radio port; for the HiPer Lite system, select Port C

  –Port baud rate: select the baud rate for the radio; for the HiPer Lite system, select 38400

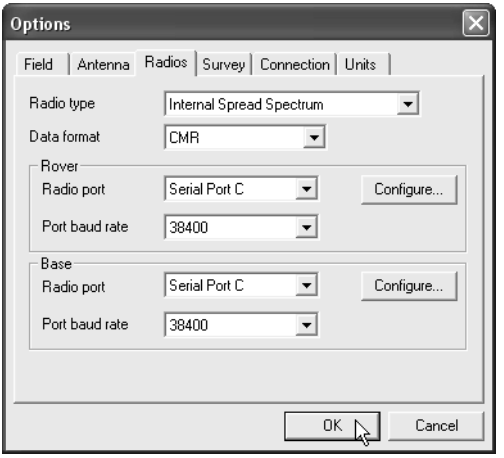


Figure 4-30. Options Dialog Box – Radios Tab

- Configure – for UHF radios only, click to set channel parameters for the Rover/Machine Receiver and Base Transmitter
  The Base Transmitter and Machine Receiver must be set to the same channel. Typical settings for Pacific Crest PDL UHF radios use serial port C and a 38400 baud rate.

Click **OK** to save the selected parameters and close the ***Options*** dialog box. Or click another tab to view or make changes on the ***Options*** dialog box.

Survey Options

The *Survey* tab displays the following options (Figure 4-31):

- Number of GPS measurements (BM surveys) – enter the minimum number of GPS measurements to average into a single benchmark survey solution

  The number of GPS measurements also defines the number of seconds the receiver must remain at a point during benchmark surveys.

  Note that this value only applies to benchmark surveys.

- Rotate view in auto-pan – click to have the Design View track the vehicle's movement during the survey

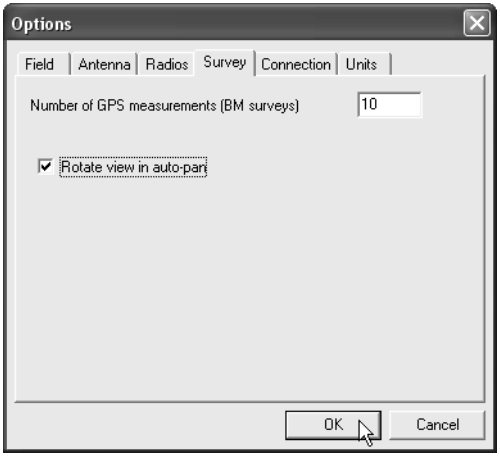


Figure 4-31. Options Dialog Box – Survey Tab

Click **OK** to save the selected parameters and close the ***Options*** dialog box. Or click another tab to view or make changes on the ***Options*** dialog box.

Connection Options

The *Connection* tab assigns the COM port for connecting a computer to the receiver (Figure 4-32).

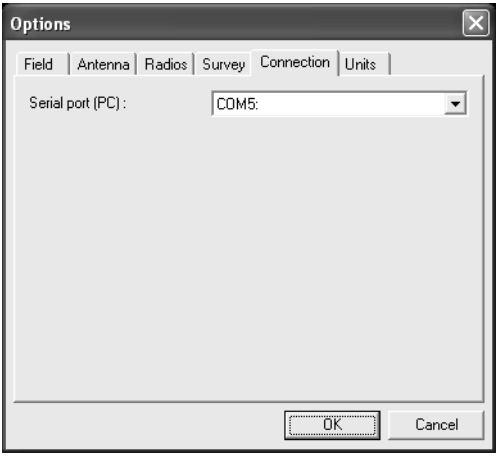


Figure 4-32. Options Dialog Box – Connection Tab

For connections with Bluetooth wireless technology, follow this procedure to set the COM port:

1. Use “My Bluetooth Places” in Microsoft® Windows to configure the Bluetooth serial port, and to detect and connect to the Hiper Lite receiver.
2. In “My Bluetooth Places”, view the device properties to see which COM port has been assigned to the Bluetooth serial port.
3. In the AGForm-3D *Connection* tab (Figure 4-32), select the same COM port from the drop-down list.

Units Options

The *Units* tab displays the following information (Figure 4-33):

- Distances – select either Meters, US Survey feet, or International feet.
- Angles – select either DD°MM'SS", NDD°MM'SS"E, Gons, or DD.DDDD°.
- Grades – select either Percent (%), Run : Rise, or Rise : Run
- Areas – select either Square meters, Square feet, Acres, or Hectares.
- Volumes – select either Cubic meters or Cubic yards.
- Coordinates – select either North-East-Elev, East-North-Elev, or X-Y-Z

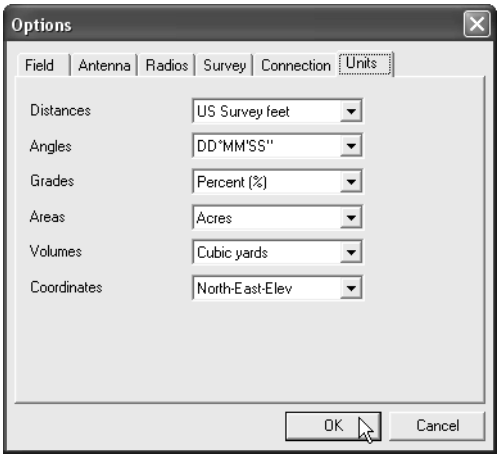


Figure 4-33. Options Dialog Box – Units Tab

Click **OK** to save the selected parameters and close the ***Options*** dialog box. Or click another tab to view or make changes on the ***Options*** dialog box.

Notes:

Surveying with AGForm-3D

When connected to a receiver, AGForm-3D can perform surveys, navigate to points, and perform surface checks.

For all procedures in this chapter, a GPS receiver must be connected to a computer (laptop) with AGForm-3D installed.

Configuring the GPS Base Transmitter

Configuring the Base Transmitter ensures that proper information is transmitted to the machine's receiver. When AGForm-3D configures the Base Transmitter, it tells the receiver what type of data to transmit, what serial port to send it from, and at what speed to send the data to the receiving radio.

NOTICE *NOTICE*

To comply with RF exposure requirements, maintain at least 20cm between the user and the HiPer® Lite receiver.

1. Using the RS232 cable, connect the serial port of the computer (usually COM1) to the receiver's serial port A. Turn on the computer and the receiver.

NOTICE *NOTICE*

If AGForm-3D is already connected to the receiver, click press F6 to disconnect from the receiver.

2. Open AGForm-3D on the computer and click **Survey-> Configure GPS base station** (Figure 5-1).

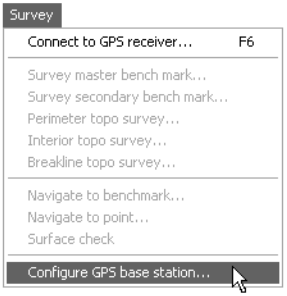


Figure 5-1. Configure GPS Base Station

3. When configuring the Base Transmitter for the first time, the ***GPS base station*** dialog box displays (Figure 5-2). Click **OK**.

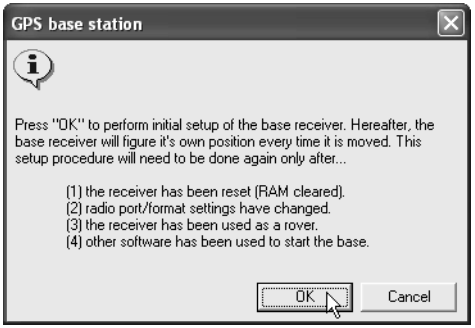

GPS base station
Press "OK" to perform initial setup of the base receiver. Hereafter, the base receiver will figure it's own position every time it is moved. This setup procedure will need to be done again only after...
(1) the receiver has been reset (RAM cleared).
(2) radio port/format settings have changed.
(3) the receiver has been used as a rover.
(4) other software has been used to start the base.
OK
Cancel

Figure 5-2. GPS Base Station Configuration Information

4. Once the base transmitter is configured, click **OK** on the confirmation dialog box (Figure 5-3).

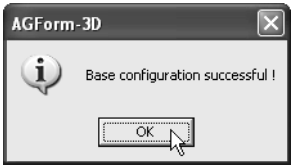


Figure 5-3. Configuration Successful

Once configured, the base transmitter will determine its own position every time it is turned on. After the initial configuration, the setup procedure will only need to be performed under the following situations:

- the receiver has been reset
- radio port/format settings have changed
- the receiver has been used as a rover
- other software has been used to start the receiver

Transmitter and Receiver Setup

The transmitter can be set up and taken down on a daily basis; however, if the transmitter's exact position has changed, the master benchmark must be re-surveyed with the GPS receiver mounted on the machine. Otherwise, a transmitter position error will cause errors in any GPS surveying or navigation routines. A tripod or pole mounted in one location for the duration of the project will eliminate the need to re-survey the benchmark each day (Figure 5-4).

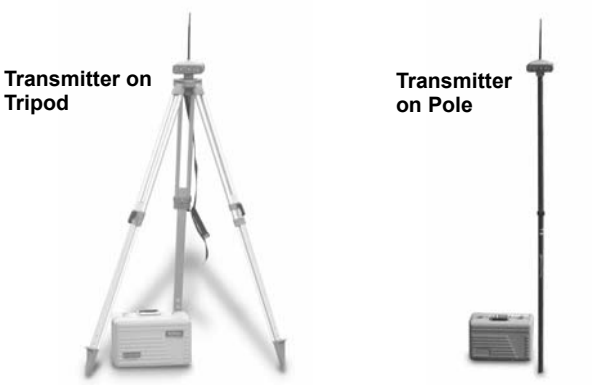


Figure 5-4. Place Transmitter at the Master Benchmark Location

TIP

The transmitter mounts with a standard 5/8” x 11 threaded bolt. A “permanent” transmitter location could be any 5/8” stud in a well, head gate, fence post, etc.

Setting up the Transmitter

After configuring the transmitter, follow these steps to set it up at the Base Transmitter location:

1. Attach the HiPer Lite to the tripod, pole, or some other “permanent” location (Figure 5-4 on page 5-3).
2. If using an external power source (Figure 5-5 on page 5-5) (such as a portable battery or a vehicle battery), do the following:
   - Connect the SAE-to-SAE extension cable and the alligator clip-to-SAE cable together.
   - Plug the power cable into the HiPer Lite power port.
   - Attach the alligator clip to the battery.

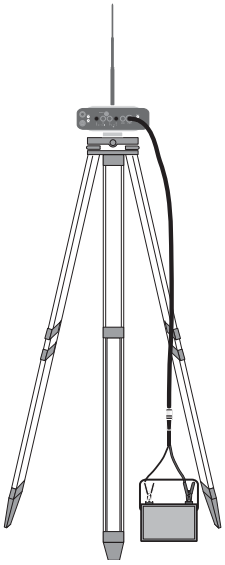


Figure 5-5. Transmitter Connected to an External Power Source

3. Press the green **PWR** button. Once the transmitter is powered up, it begins tracking satellites. The STAT LED blinks, indicating the number of tracked satellites.

NOTICE *NOTICE*

If the receiver does not turn on, it may be in Zero Power Mode. Press the Reset key for one second to return to Normal Mode.

Setting up the Machine Receiver

1. Attach the receiver to a stable mount on the vehicle.
2. Measure the height of the antenna from the ground directly beneath the receiver to the edge of the receiver (Figure 5-6 on page 5-6).

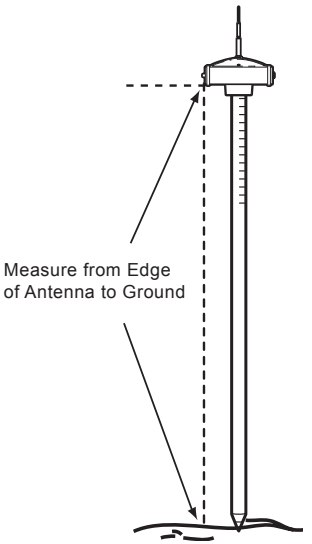


Figure 5-6. Measure Antenna Height

3. Connect the receiver and a laptop as shown in “Connecting to the Receiver” on page 5-7.
4. Enter the antenna height value into AGForm-3D. Click **Tools->Options** and click the *Antenna* tab.
5. Press the green **PWR** button. Once the transmitter is powered up, it begins tracking satellites. The STAT LED blinks, indicating the number of tracked satellites. The RX LED blinks, indicating it receives a signal from the Base Transmitter.

Shutting Down the Transmitter & Receiver

1. Press the **PWR** key for more than one second but less than four seconds.
2. Remove the HiPer Lite from its mount. If using a “permanent” pole, leave the pole in place to use the following day. If using a tripod or other non-permanent mount, dismantle it until ready to use again.

Connecting to the Receiver

Use an RS232 cable to connect the receiver and a computer (laptop).

1. Using the RS232 cable, connect the serial port of the computer (usually COM1) to the receiver's serial port A. Turn on the computer and the receiver.
2. Open AGForm-3D on the computer and click **Survey-> Connect to GPS receiver** or press **F6** (Figure 5-7).

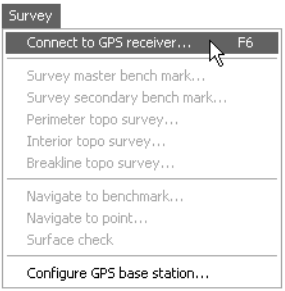


Figure 5-7. Connect to GPS Receiver

Once connected, the ***GPS*** pane displays in the Tab View with the following information (Figure 5-8 on page 5-8):

- receiver ID number and firmware version
- GPS coordinates (XYZ or LLH) and the receiver's current position
- fix status of the receiver:

  –Initialized: AGForm-3D has a solved position and is "fixed"

  –Initializing: AGForm-3D is attempting to solve a position

  –Waiting for Satellites: AGForm-3D is attempting to track enough satellites fo get a fixed position

- satellite status and positioning quality based on the satellites currently being tracked

  The RMS (Root Mean Square) value is an estimate of the position precision. The position DOP (Dilution of Precision) is an indicator of the strength of the satellite geometry. Lower DOP values indicate stronger geometry.

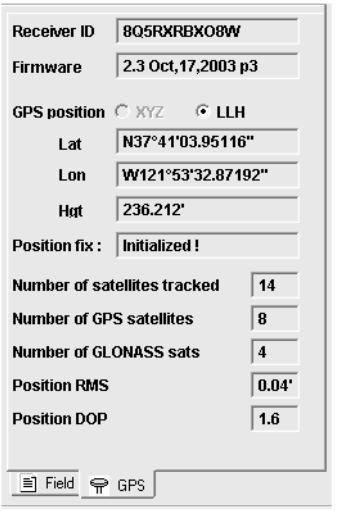


Figure 5-8. GPS Pane in Tab View

Surveying Benchmarks

Data in AgForm-3D projects are assigned 3D coordinates, the format of which is set in the ***Options*** dialog. Coordinates are a grouping of three values that specify the position of a point. These coordinate values are physically realized by surveying benchmarks with known positions.

AGForm-3D has two types of benchmarks: Master and Secondary.

- A single master benchmark is required for each project and can be set anywhere on or around the project site.
- One or more secondary benchmarks can be established as needed. These can be set anywhere on or around a project site.

NOTICE

All benchmarks within the perimeter of the field will be included in the computation of the terrain model (TIN).

Surveying the Master Benchmark

The master benchmark (MB) ties the local project coordinates to GPS coordinates and should be located somewhere on or around the project.

Once the Base Transmitter is set up and turned on, the MB can be surveyed. As long as the location of the Base transmitter remains permanent throughout the duration of the project, the MB will not need to be re-surveyed. See “Changing the Master Benchmark Location” on page 5-15 for conditions that require a re-survey of the master benchmark.

TIP

Survey additional (Secondary) benchmarks to use as backups for the MB.

1. Setup the receiver directly over the master benchmark to be surveyed, and connect the receiver and a laptop (see “Connecting to the Receiver” on page 5-7 for details).
2. Click **Field->Master bench mark** (Figure 5-9).

Figure 5-9. Create Master Benchmark

3. On the ***Master bench mark*** dialog box, click the **Name** entry box and enter a name for the master benchmark. If desired, enter a description for the benchmark. Enter the grid coordinates for the master benchmark or accept the default values (Figure 5-10).

   For new master benchmarks, the default name is “BM1” and the default grid coordinates are 0.00, 0.00, and 100.00.

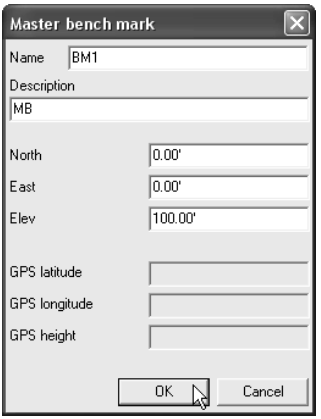


Figure 5-10. Create New Master Benchmark

4. Click **OK** to save the information.
5. Click **Survey->Survey master bench mark** (Figure 5-11). The *Bench mark survey* pane displays in the Tab View.

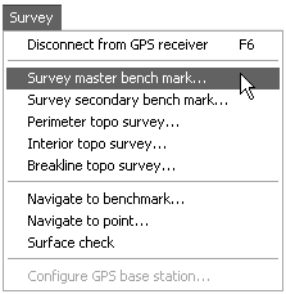


Figure 5-11. Survey Master Benchmark

6. On the *Bench mark survey* Pane, click **Start** or press **F8** (Figure 5-12).

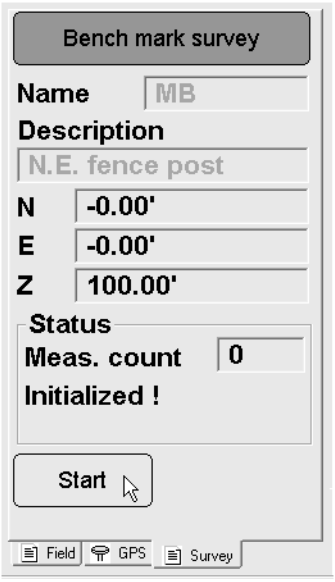


Figure 5-12. Measure Benchmark – Click Start

AGForm-3D surveys the benchmark according to the number of measurement epochs set in the *Survey* tab (accessed through **Tools->Options**).

When finished, the *Bench mark survey* pane displays the number of measurements counted (Figure 5-13).

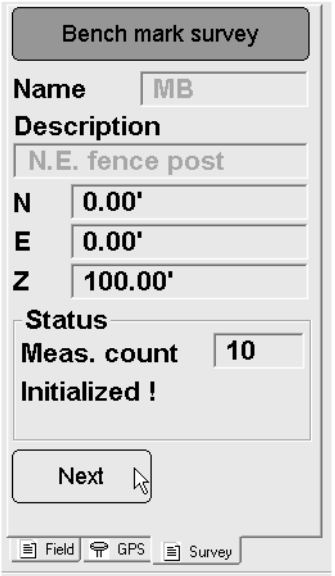


Figure 5-13. Master Benchmark Surveying Complete

7. See “Viewing Master Benchmark Information” on page 2-2 and “Editing the Master Benchmark” on page 2-4 to view, edit, or save benchmark information.
8. Click **Survey->Stop bench mark survey** or press **F7** to complete the survey.

Surveying Secondary Benchmarks

Secondary benchmarks serve as reference points for:

- control points to set or verify grade
- backup for the master benchmark

While secondary benchmarks are not required, having one or more is always a good idea; you can survey as many secondary benchmarks as needed.

NOTICE *NOTICE*

All benchmarks within the perimeter of the field will be included in the computation of the terrain model (TIN).

Before measuring benchmarks with AGForm-3D, the receiver and a computer (laptop) must be connected. See "Connecting to the Receiver" on page 5-7 for details on the connection process.

1. Position the receiver over the location of a secondary benchmark.
2. Click **Survey->Survey secondary bench mark** (Figure 5-14).

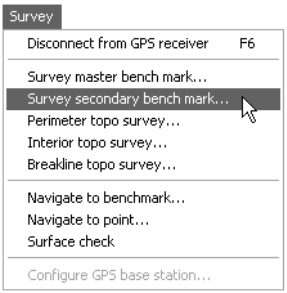


Figure 5-14. Survey Secondary Benchmark

3. On the *Bench mark survey* pane, enter a name and description for the benchmark, then click **Start** or press **F8**.

AGForm-3D measures the current position of the receiver and logs it as a secondary benchmark (Figure 5-15).

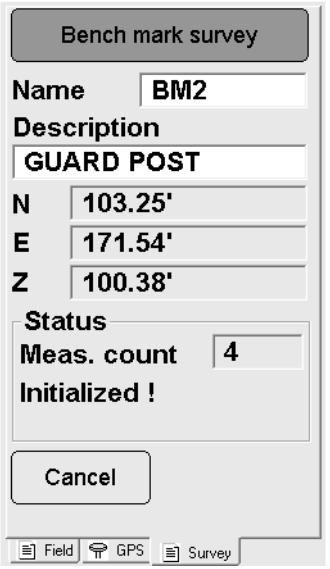


Figure 5-15. Measure Benchmark – Click Start

The coordinates remain "frozen" until you click **Next**.

4. To measure other secondary benchmarks, click **Next** (Figure 5-16) and repeat steps 1 through 3 on page 5-13.

   Once you click **Next**, the coordinates become "live" and update as the antenna moves.

Figure 5-16. Click Next to Prepare to Log Another Benchmark

5. See Chapter 2 for information on viewing, editing, or saving benchmark information.
6. When finished measuring secondary benchmarks, click **Survey->Stop bench mark survey** or press **F7** to stop the survey.

Changing the Master Benchmark Location

If the master benchmark location has been moved or altered, use this procedure to re-survey a secondary benchmark and make it the new MB.

1. To edit or view secondary benchmark information, click **Field->Secondary bench marks** (Figure 5-17).

Figure 5-17. View Secondary Benchmarks

The ***Bench marks*** dialog box displays the name and description of all secondary benchmarks (Figure 5-18).

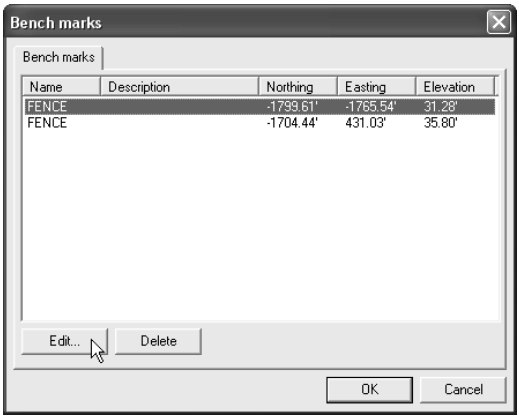


Figure 5-18. Secondary Benchmarks List

2. Select the secondary benchmark to re-survey as the master benchmark and click **Edit** (Figure 5-18).

3. On the ***Edit bench mark*** dialog box, record the coordinates for the selected benchmark (Figure 5-19). Click **OK** to exit.

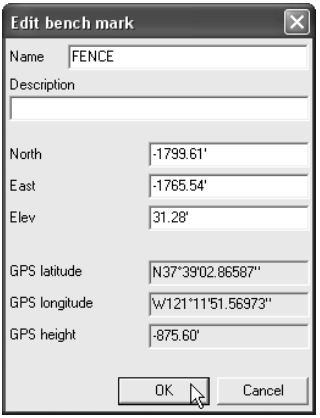


Figure 5-19. Record Coordinates

4. Click **Field->Master bench mark**. On the ***Master bench mark*** dialog box, change the MB's site coordinates to match those of the secondary benchmark. Re-name or change the description of the MB to reference the new position (Figure 5-20). Click **OK** to set the grid coordinates.

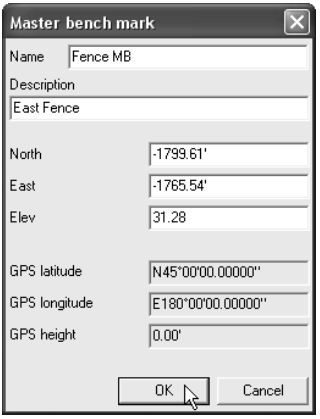


Figure 5-20. Enter Secondary BM Coordinates as MB Coordinates

5. Re-survey the master benchmark at this new location. Position the receiver over the benchmark. Click **Survey ->Survey master bench mark** and click **Start** on the *Survey* pane of the Tab View or press **F8**.
6. When finished, the GPS latitude, longitude, and height coordinates update on the *Survey* pane and the ***Master bench mark*** dialog box (Figure 5-21).

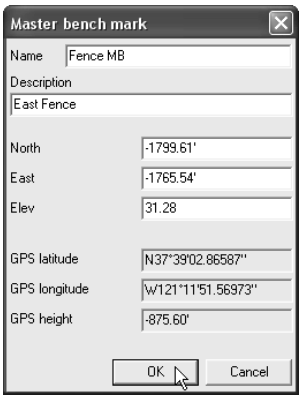


Figure 5-21. WGS84 Coordinates Updated for New MB Location

Surveying the Field

A field survey collects data in order to build a model of the existing terrain and to design surfaces that fit the existing terrain to required specifications. Using AGForm-3D, the survey is typically carried out in a vehicle (such as a pickup truck) with the GPS antenna mounted to the vehicle in such a way that its height above ground can be determined.

A typical survey will consist of collecting data around the perimeter of the field and at points in its interior. For convenience, points can be collected in automatic mode at a specified sampling interval. A good surveying practice is to collect points in a uniform fashion (consistent spacing) throughout the field. Grid lines displayed in the Design View during the survey help the operator to survey in this

fashion. Also, the Design View can be set to autopan mode so the operator can track the vehicle's movement along the grid lines during the survey. Survey breaks in the terrain, such as ridge lines or swells, using the "breakline survey" mode for enhanced terrain modeling.

AGForm-3D performs three types of surveying: Perimeter, Interior, and Breakline.

Performing a Perimeter Survey

A perimeter survey determines the border of the field, which is necessary for accurate terrain modeling and for automated grading using the AGS-100 control system.

1. Setup the Base Transmitter and Machine Receiver as described in "Transmitter and Receiver Setup" on page 5-3.
2. Connect the computer and Receiver as seen in "Connecting to the Receiver" on page 5-7 and open AGForm-3D.
3. Click **Survey->Perimeter topo survey** (Figure 5-22) to display the ***Perimeter survey*** pane in the Tab View.

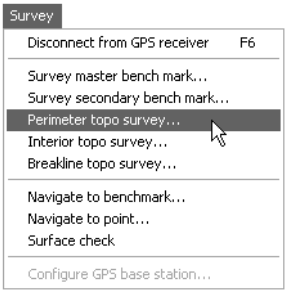


Figure 5-22. Perform Perimeter Topo Survey

4. On the ***Perimeter survey*** pane, set the minimum distance interval for taking readings and click **Start auto** or press **F8** (Figure 5-23).

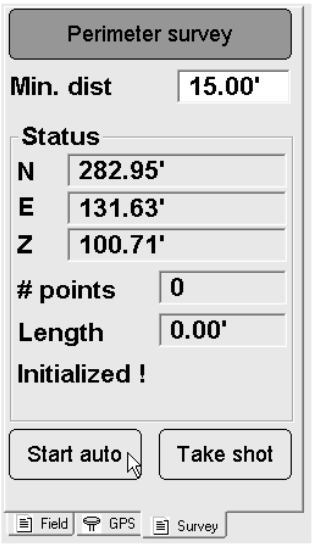


Figure 5-23. Perimeter Survey Pane

5. Begin driving around the edge of the field as close to the edge as possible (Figure 5-24).

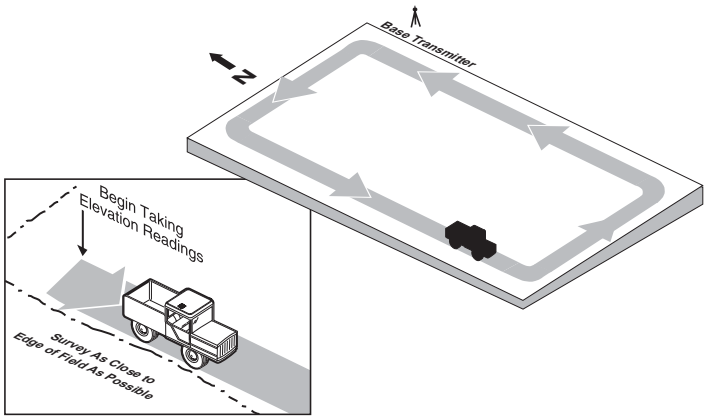


Figure 5-24. Perimeter Survey

When the minimum distance has been reached, AGForm-3D will record and save the point. The number of perimeter points, the length of the perimeter, and the Design View update with each point taken (Figure 5-25).

- Click **Take shot** or press **F9** to take measurements between the automatic reading.
- Click **Stop auto** to pause taking readings. Click **Resume** to continue taking readings. Press **F8** to toggle between stop and resume.

TIP

Click the Auto-pan button on the toolbar (the red truck) to display the current position of the GPS receiver in the Design View.

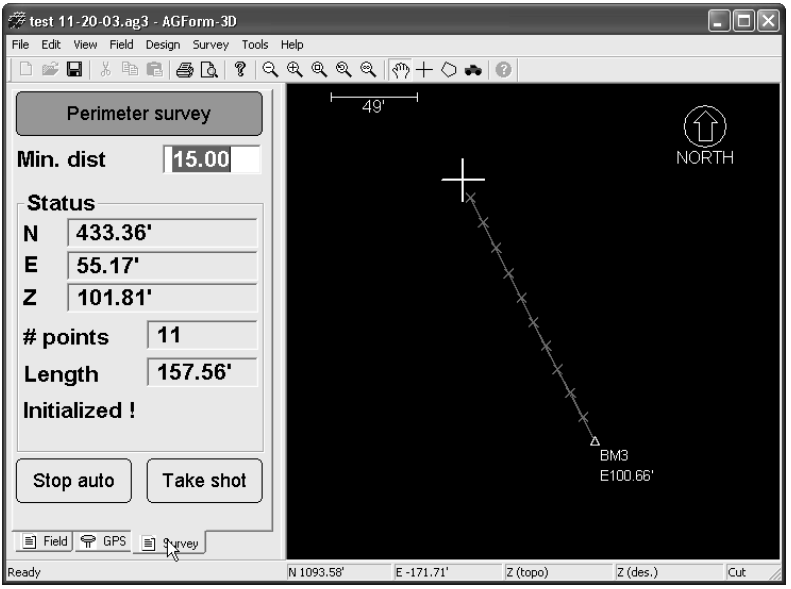


Figure 5-25. Perimeter Survey Pane and Display View

6. When finished, click **Stop auto** on the *Survey* pane or press **F8** (Figure 5-25 on page 5-20).
7. To leave the perimeter surveying function, click **Survey-> Stop perimeter survey** or press **F7**.

Performing an Interior Survey

Interior surveys provides additional data readings used to generate the terrain model.

The interior survey will generally be performed in a grid-like fashion. Generally, the most efficient way to do this is to drive in a serpentine pattern (Figure 5-26). Use the grid tool to help space each leg evenly.

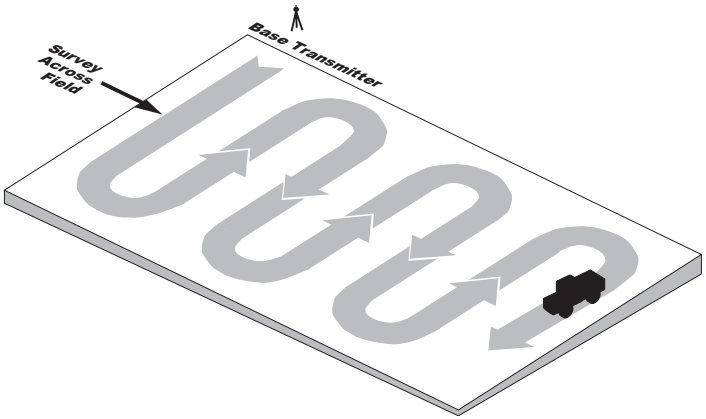


Figure 5-26. Serpentine Survey

1. Setup the Base Transmitter and Machine Receiver as described in “Transmitter and Receiver Setup” on page 5-3.
2. Connect the computer and Receiver as seen in “Connecting to the Receiver” on page 5-7 and open AGForm-3D.

3. Click **Survey->Interior topo survey** (Figure 5-27) to display the ***Interior survey*** pane in the Tab View.

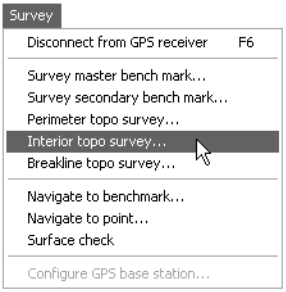


Figure 5-27. Perform Interior Topo Survey

4. On the ***Interior survey*** pane, enable the desired parameters and click **Start** or press **F8** (Figure 5-28 on page 5-23).

   - Minimum distance interval – sets the minimum distance for taking readings
     The default is 50ft.
   - Check dist to all points – checks the distance from the current antenna location to all existing points in the data base
     If any existing point is within the minimum distance from the current antenna location, a measurement will not be taken. Note that AGForm-3D may run slower with this option enabled.

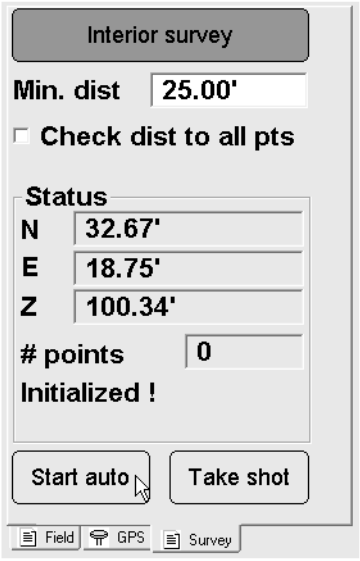


Figure 5-28. Interior Survey Pane

5. Begin driving. When the minimum distance has been reached, AGForm-3D will record and save the point. The number of interior points increases with each point taken (Figure 5-29 on page 5-24).
   - Click **Take shot** or press **F9** to take measurements between the automatic reading.
   - Click **Stop auto** to pause taking readings. Click **Resume** to continue taking readings. Press **F8** to toggle between stop and resume.

TIP

Click the Auto-pan button on the toolbar (the red truck) to display the current position of the GPS receiver in the Design View.

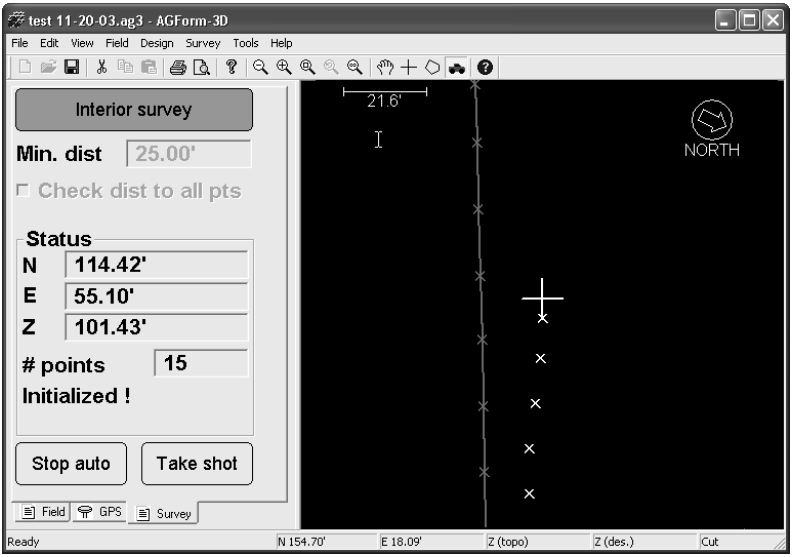


Figure 5-29. Interior Survey Pane and Display View

6. When finished, click **Stop auto** or press **F8** (Figure 5-29).
7. To leave the interior surveying function, click **Survey-> Stop interior survey** or press **F7**.

Performing a Breakline Survey

A breakline survey delineates the natural breaklines in the terrain, such as ridges and swales. If such natural breaklines exist in the filed, surveying them with the breakline survey routine will result in a more accurate model of the terrain (TIN model).

1. Setup the Base Transmitter and Machine Receiver as described in “Transmitter and Receiver Setup” on page 5-3.
2. Connect the computer and Receiver as seen in “Connecting to the Receiver” on page 5-7 and open AGForm-3D.

3. Click **Survey->Breakline topo survey** (Figure 5-30) to display the ***Breakline survey*** pane in the Tab View.

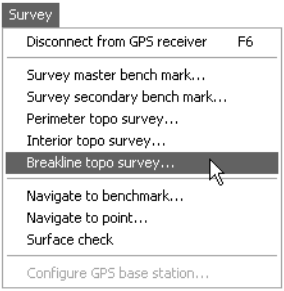


Figure 5-30. Perform Breakline Topo Survey

4. On the ***Breakline survey*** pane, set the minimum distance interval for taking readings and click **Start** (Figure 5-31).

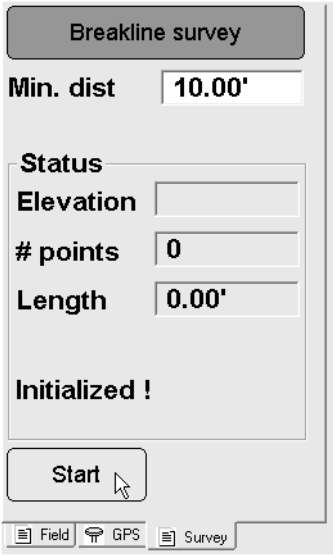


Figure 5-31. Breakline Survey Pane

5. Begin driving along the natural breakline feature. When the minimum distance has been reached, AGForm-3D will record and save the point. The number of points increases with each point collected (Figure 5-32).
   - Click **Take shot** or press **F9** to take measurements between the automatic reading.
   - Click **Stop auto** to pause taking readings. Click **Resume** to continue taking readings. Press **F8** to toggle between stop and resume.

TIP

Click the Auto-pan button on the toolbar (the red truck) to display the current position of the GPS receiver in the Design View.

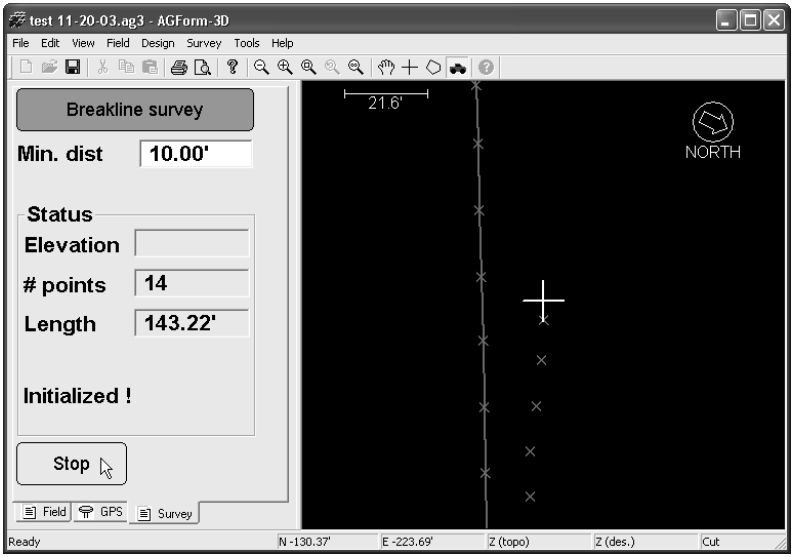


Figure 5-32. Breakline Survey Pane and Display View

6. When finished, click **Stop** or press **F8** (Figure 5-32 on page 5-26).
7. To leave the breakline surveying function, click **Survey-> Stop breakline survey** or press **F7**.

Navigating to a Benchmark

Use the navigate to benchmark function in AGForm-3D to locate benchmarks that have been covered or are difficult to find. This function can also be used to navigate precisely to a benchmark when making checks during a survey.

1. Setup the Base Transmitter and Machine Receiver as described in “Transmitter and Receiver Setup” on page 5-3.
2. Connect the computer and Receiver as seen in “Connecting to the Receiver” on page 5-7 and open AGForm-3D.
3. Click **Survey->Navigate to benchmark** (Figure 5-33) to display the *Navigate to BM* pane in the Tab View.

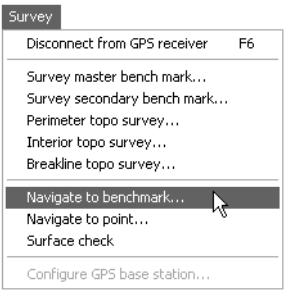


Figure 5-33. Navigate to Benchmark

4. On the *Navigate to BM* pane, select the benchmark to navigate to in the *Name* field. The *Status* section displays the coordinates of the Benchmark and the current position of the receiver in relation to the benchmark (Figure 5-34).

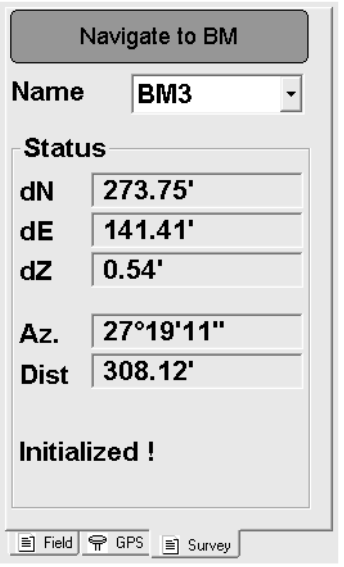


Figure 5-34. Navigate to BM Pane

5. Drive towards the benchmark; the *Az.* and *Dist* fields continuously update depending on the position of the receiver in relation to the selected benchmark.
6. To leave the navigate to benchmark function, click **Survey-> Stop navigation** or press **F7**.

Navigating to a Point

Use the navigate to point function in AGForm-3D to navigate to any point in the database. You can select any point in the Points List or in the Design View, or manually enter coordinates to which to navigate to.

1. Setup the Base Transmitter and Receiver as described in “Transmitter and Receiver Setup” on page 5-3.
2. Connect the computer and Receiver as seen in “Connecting to the Receiver” on page 5-7 and open AGForm-3D.
3. Click **Survey->Navigate to point** (Figure 5-35) to display the *Navigate to point* pane in the Tab View.

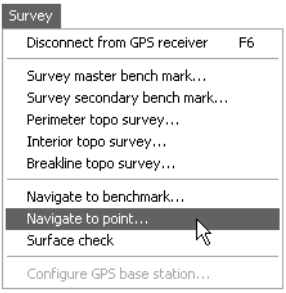


Figure 5-35. Navigate to Point

4. Click a point in the Design View to navigate to, or on the *Navigate to Point* pane:
   - Select *To coordinates* to enter coordinate manually.
   - Select *To data point* if you know the point name or number. Since point names are not unique between types, select the type of point to navigate to. If no point is selected in the Design View, the default point to navigate to is the first point of this type.
5. Click **Start** and begin driving towards the point.

The *Status* section of the pane displays the current coordinates; the *Az.* and *Dist* fields continuously update to reflect the position of the receiver in relation to the selected point (Figure 5-36).

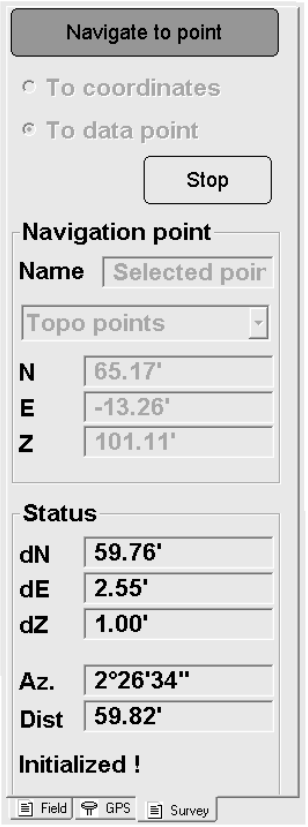


Figure 5-36. Navigate to Point Pane

6. When positioned over the desired point, click **Stop** or press **F8**.
7. If desired, select or enter another point to navigate to.
8. To leave the navigate to point function, click **Survey->Stop navigation** or press **F7**.

Performing a Surface Check

A surface check displays the difference between the ground and the design surface at the current position. A surface check is useful for checking the progress of a current grading project. A design surface must exist in order to perform a surface check.

1. Setup the Base Transmitter and Receiver as described in “Transmitter and Receiver Setup” on page 5-3.
2. Connect the computer and Receiver as seen in “Connecting to the Receiver” on page 5-7 and open AGForm-3D.
3. Click **Survey->Surface Check** (Figure 5-37) to display the *Surface check* pane in the Tab View.

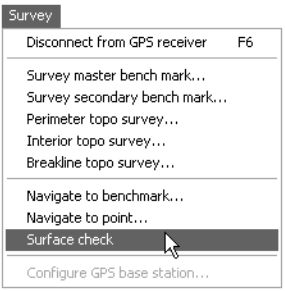


Figure 5-37. Perform Surface Check

AGForm-3D checks the existing surface against the design surface at the point of the receiver. The coordinates of the vehicle and the cut/fill to the design surface display on the *Surface check* pane (Figure 5-38 on page 5-32).

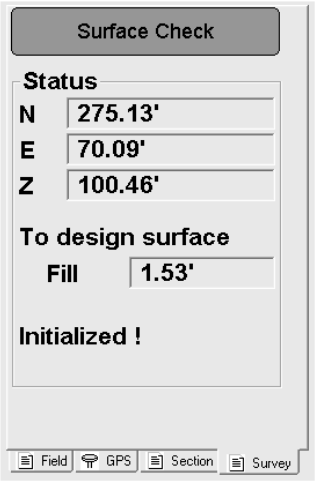


Figure 5-38. Surface Check Pane

4. To leave the surface check function, click **Survey->Stop surface check** or press **F7**.

Disconnecting From the GPS Receiver

To disconnect from the GPS receiver, click **Survey->Disconnect from GPS receiver** or press **F6** (Figure 5-39).

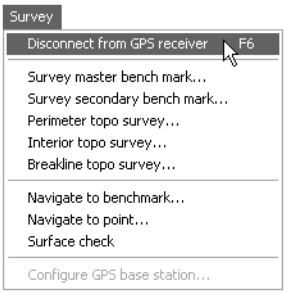


Figure 5-39. Disconnect from GPS Receiver

Disconnect the cable from the computer and receiver, and store the cable in a safe place.

Hot Keys

Table A-1 lists common keyboard shortcuts, or hot keys, for AGForm-3D.

Table A-1. AGForm-3D Hot Keys

Press This...	To Perform this Function...
Ctrl+A	Selects all (in active view).
Ctrl+C	Copies the selected information to the clipboard.
Ctrl+N	Displays the ***New Project Name*** dialog box for naming and opening a new project.
Ctrl+O	Displays the ***Open*** dialog box for selecting a project to open.
Ctrl+P	Displays the ***Print*** dialog box for printing the Design View.
Ctrl+S	Saves the project.
Ctrl+V	Pastes copied information to the selected location.
Ctrl+X	Cuts the selected information for pasting to the clipboard.
Ctrl+Y	Redoes the last operation.
Ctrl+Z	Undoes the last operation.
Arrow keys	Pans the map left, right, up, and down.
End	Zooms to the previous view.
Home	Zooms to the extent of the project.
Page Down	Zooms out.
Page Up	Zooms in.
Esc	Quits the Measure distance/area and Profile view functions.

Table A-1. AGForm-3D Hot Keys (Continued)

Press This...	To Perform this Function...
F2	Allows in-place editing in the point list.
F4	Regenerates field contours.
F5	Toggles between panes (field, section, survey, etc.) from left to right.
F6	Connects/disconnects to GPS receiver.
F7	Stops any active survey.
F8	Emulates the Start/Stop button in all Survey and Navigation panes that have this button.
F9	Emulates the Take Shot button in all Survey panes that have this button.

Hot keys that correspond to a menu option are listed next to the menu option (Figure A-1).

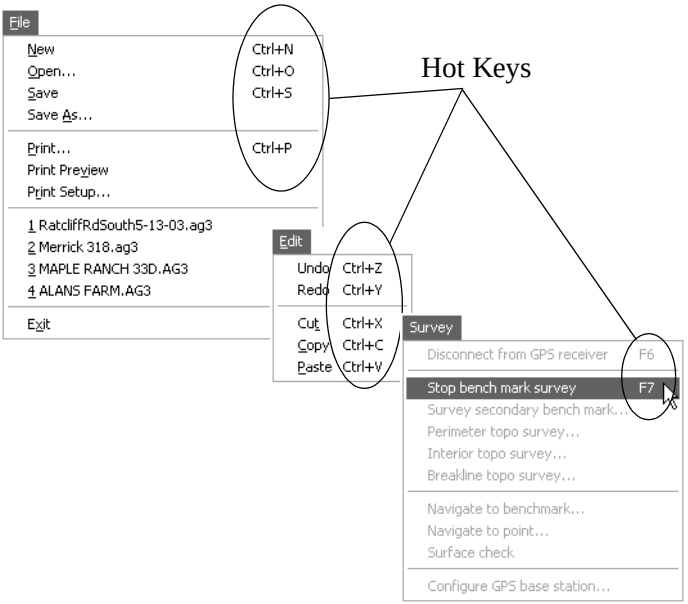


Figure A-1. Menu Option Examples with Hot Keys

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